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National Park Service Vegetation Inventory Program

Apostle Islands National Lakeshore, Wisconsin

Natural Resource Report NPS/GLKN/NRR—2010/199



ON THE COVER
Mosaic of fieldwork and various scenes at the Apostle Islands National Lakeshore.
Photographs by: Kevin Hop

National Park Service Vegetation Inventory Program

Apostle Islands National Lakeshore, Wisconsin

Natural Resource Report NPS/GLKN/NRR—2010/199

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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. The USGS Upper Midwest Environmental Sciences Center, NatureServe, NPS Great Lakes Network, and NPS Apostle Islands National Lakeshore have completed vegetation classification and mapping of Apostle Islands National Lakeshore (APIS) and surroundings.

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 153 vegetation sampling plots within the APIS project extent. Furthermore, data from 687 accuracy assessment (AA) sites were collected (of which 673 were used to test the accuracy of the vegetation map layer). These data sets led to the identification of 48 vegetation associations in the NVCS at the APIS. Additional vegetation types are recognized at the group level in the NVCS.

A total of 63 map classes were developed to map the vegetation and general land cover of APIS and environs, including the following: 58 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 four 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 2004 (during fall leaf change). Polygon units were mapped mostly to a 0.5-ha minimum mapping unit. An ancillary set of 1:24,000-scale, true-color aerial photos dated April 2005 (during leaf-off conditions) covering the entire APIS 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 APIS vegetation map provides 4,862 polygons of detailed attribute data covering 28,971.9 ha, with an average polygon size of 6.0 ha. Of the area mapped, 4,732 polygons (97.4%) represent natural/semi-natural types in the NVCS, encompassing 17,600.9 ha (60.8%) 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 88.9% of polygons and covering 96.6% of area, and are largely dominated by the Maple - Yellow Birch Northern Hardwoods Forest community. A thematic AA was conducted of map classes representing floristic types in the NVCS. Results present an overall accuracy of 87.7% (kappa index of 87.2%) based on data from 673 of the 687 AA site data. Most individual map-class themes exceed the NPS VIP standard of 80%, with a 90% confidence interval.

The APIS 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 project boundary. All geospatial products are projected in Universal Transverse Mercator, Zone 15, 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 skill and expertise, essential in moving the National Park Service (NPS) Apostle Islands National Lakeshore (APIS) 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 APIS 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 (GLKN) 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, for providing an additional set of spring, leaf-off, true-color aerial photographs (which greatly assisted us in our mapping), and also for assisting us with some accuracy-assessment data collection on the mainland. In addition, we much appreciate Ted Gostomski (GLKN) for his devotion and expertise with boat transportation, getting us safely to and from islands.

Thanks are also in order to the NPS APIS staff—particularly Julie Van Stappen and Peggy Burkman—for hosting this project with its series of meetings, training sessions, and field efforts. They provided the project with valuable local knowledge of the APIS landscape and insight into local management and research needs.

We also acknowledge and thank our field teams who spent many hours collecting the data that formed the basis of so much of this project. We bestow thanks to Eric Epstein who provided us vast knowledge and expertise of plant communities at the APIS and the classification thereof. We give recognition to our lead ecologists for the vegetation-plot collection, including the following: Eric Epstein, Janet Marr, and Carol Reschke. They were assisted by Christina Isenring, Matt Smith, and Matt Volenec. We also give recognition to our lead ecologists for the accuracy assessment (AA) site collection, including Chris Groebner and Janet Marr. They were assisted by Bob Dunlap, Ken Hiser, and Neal Murphy. In addition, we are grateful to the following NPS staff for assisting in AA collection toward the end of the field season—we would not have made it without your help: A. Derix, A. Kirshbaum, U. Gafvert, T. Gostomski, and J. Grochowski.

We finally thank our colleagues from within our own offices—the USGS Upper Midwest Environmental Sciences Center and NatureServe. Of the USGS, we acknowledge Eric Seeger for assisting with field work and quality control of the photointerpretation mapping, as well as his role in the analysis for AA; Janis Ruhser for orthorectification and map automation; and JC Nelson and the student geographic information system lab for quality control of map automation,

as well as 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; and Don Faber-Langendoen for consulting with us on the vegetation classification.

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

Apostle Islands National Lakeshore Vegetation Mapping Project

The Apostle Islands National Lakeshore (APIS) 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 APIS. The goals of the project are to adequately describe and map plant communities of APIS and immediate surroundings and provide the NPS Natural Resource Inventory and Monitoring (I&M) Program, resource managers, and biological researchers with useful baseline vegetation information.

The APIS 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 APIS vegetation mapping project November 2004 with a scoping meeting wherein partners discussed project objectives, goals, and methods. Major collaborators at this meeting included staff from the NPS GLKN, the NPS APIS, NatureServe and their constituents, and the USGS. Common to all NPS VIP projects, the three major components of the APIS vegetation mapping project are as follows: (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 to 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
Upper: 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.)
Middle: 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.)
Lower: Floristics plays a predominant role.	
Alliance	*Fraxinus nigra* - *Acer rubrum* Saturated Forest (A.347)
Association	*Fraxinus nigra* - Mixed Hardwoods - Conifers / *Cornus sericea* / *Carex* spp. Forest (CEGL002105)

Table 3. Hierarchy for cultural vegetation (with examples) in the National Vegetation Classification Standard (Version 2).

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

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).

Apostle Islands National Lakeshore

Location and Brief History

The APIS (Figure 1) is located in the northern-most lands of Wisconsin, on the south shore of Lake Superior, stretching across the two counties of Bayfield and Ashland. The APIS includes 21 of the 22 islands of the Apostle archipelago within Lake Superior (Madeline Island is not part of APIS) and about 19 km of the northwest shores of the Bayfield Peninsula. The APIS was authorized in 1970 by the U.S. Congress to conserve the natural resource. In 1986, Long Island, now a peninsula connecting to Chequamegon Point, was added. The APIS comprises an area of 28,074 ha, which includes just over 400 m of surface water jurisdiction offshore from each island and the mainland into Lake Superior. Land inside the APIS boundary consists of 17,104 ha, of which the NPS owns 17,062 ha.



Figure 1. Apostle Islands National Lakeshore, Wisconsin (courtesy nps.gov).

In the past, the APIS area was home to the Ojibwe people. Later on, the area became a major fur trading center, followed by extensive logging, brownstone quarrying, farming, commercial fishing, and tourism. Several lighthouse stations speckle the archipelago to guide the shipping industry. These lighthouse stations were built during the latter half of the 19th century and have, in some cases, helped protect some of the vegetation landscape from logging, leaving some virgin timber. Each of the islands and the mainland has their own unique history. Busch (2008) provides a detailed survey on human history of the Apostle Islands. Eastern National (2001) provides a brief synopsis of the history to several of the islands and the mainland.

Landscape Setting

Of the islands within the APIS area, Stockton Island is the largest at nearly 4,000 ha (about 9,850 acres), with Outer Island a close second at just over 3,150 ha (about 7,800 acres); both these islands are predominantly populated with northern hardwood forest. Gull Island, just off of the northeast tip of Michigan Island, is the smallest at less than 1 ha (just over 2 acres), consisting mostly of a sandy herbaceous and shrub mix[1]. Most islands consist of sandy and clayey till over sandstone bedrock. Several of the islands have sandscape features (e.g., beach, sandspit, tombolo) somewhere along the margins of the islands (e.g., the tombolo of Stockton Island, sandspits of Outer Island and Michigan Island).

[1] Approximate areas given were determined from the APIS vegetation mapping project geodatabase product.

Prior to extensive logging of the APIS area, about 90% of the archipelago was of upland mixed conifer and hardwood forest dominated by eastern hemlock (*Tsuga canadensis*), white pine (*Pinus strobus*), sugar maple (*Acer saccharum*), yellow birch (*Betula alleghaniensis*), and paper birch (*Betula papyrifera*) (see Judziewicz and Koch 1993, Howk 2001).

Today, the islands and mainland consist mostly of dense second growth northern hardwood forest with diverse understory floristics (Figure 2), some with a strong presence of white-cedar resulting in meager understory floristics (Figure 3). Eastern hemlock is dominant within relic stands surviving the logging period (Figure 4), yet with little regeneration. About 486 ha (1,200 acres) of forests at the APIS are considered old growth (NPS APIS, Peggy Burkman, pers. commun.). White pine forests are spotty and found mostly along the outer bedrock margins of islands and island sandscapes (rarely found interior) and are often mixed with hemlock and/or hardwoods (Figure 5).



Figure 2. Northern hardwood forest with diverse understory floristics.



Figure 3. White-cedar and hardwood forest with minimally diverse understory floristics.



Figure 4. Relic eastern hemlock forest with little tree regeneration.



Figure 5. White pine mixed forest near lighthouse on Michigan Island.

Within upland settings, balsam fir (*Abies balsamea*) and white-cedar (*Thuja plicata*) are common to mesic locations, whereas red oak is common to the driest locations. Each island has its own unique vegetation landscape, largely due to historical anthropogenic activity, yet also from position in the archipelago. Judziewicz and Koch (1993) provide detailed vegetation summaries for each island and the mainland. Some virgin timber stands exist from either lighthouse preservation (e.g., Outer Island) or non-economical "twisted" wood (e.g., North Twin Island).

Adding to the vegetation diversity, some islands and the mainland have sandscape formations (Figure 6) providing both sand beach/dune and lagoon settings, as dunal and wetland vegetation thrive. Most extensive and unique is the tombolo on the southeast corner of Stockton Island (Figure 7), which connects the once separated Presque Isle. In addition to sandscape lagoon wetlands, peatland basins (Figure 8) and beaver pond complexes (Figure 9) make up much of the interior island wetlands. Some islands are much denser with basin and/or beaver complex wetlands than others (e.g., mesic, low elevation island verses dry, high elevation island).



Figure 6. Sandscape of beach/dune and lagoon on western tip of Michigan Island.



Figure 7. Tombolo on Stockton Island with sand dunes and interdunal wetlands.



Figure 8. Peatland basin with leatherleaf and short black spruce and tamarack trees.



Figure 9. Beaver meadow complex, making for a dynamic landscape.

Among the many natural features in the APIS area are the picturesque sandstone formations. Some have been carved into by Lake Superior waves, resulting in sea caves (Figure 10). Furthermore, Lake Superior, with its cool maritime-like climate, influences the vegetation landscape at the APIS, bringing an element of the boreal forest region of the north into the northern hardwood forest region where the Apostle Islands are located.



Figure 10. Sea caves of Devils Island, Apostle Islands National Lakeshore.

Project Overview

General Process

The three main components of the Apostle Islands National Lakeshore (APIS) 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 APIS and immediate environs.

Color-infrared (CIR) aerial photographs of the study area were collected during fall 2004, providing aerial photos for fieldwork and mapping. True-color (TC) aerial photographs were also collected during spring 2005. The scoping meeting for the APIS vegetation mapping project was held November 18, 2004, at a Wisconsin State office in Eau Claire. At this meeting, primary partners met to discuss and plan the vegetation mapping project.

During the summers of 2005 and 2006, botanists collected vegetation samples for plant community characterization. We entered the sampling data into the National Park Service (NPS) PLOTS Database (NatureServe 2005b) and performed analyses, which provided detailed ecological information to affirm plant communities at the APIS and document them with local descriptors. The vegetation classification was later modified with additional field reconnaissance data of APIS, vegetation samples from other ongoing park units within the Great Lakes Network (GLKN), and data from AA sites.

Before mapping, we performed field reconnaissance throughout the summer of 2007 to correlate vegetation types to their appearances on the 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 2008, field crews 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, including the following: vegetation points (containing vegetation sampling plots and AA sites), vegetation and land cover polygons (showing locations of vegetation types and general land cover features such as non-vegetated open water), 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 15, using the North American Datum of 1983 (NAD83).

Scoping Meeting

We officially launched the APIS vegetation mapping project with a scoping meeting held at the Wisconsin Department of Natural Resources, West Central Region Headquarters in Eau Claire, on November 18, 2004.

Various cooperators joined together to discuss the APIS vegetation mapping project objectives and methods and to receive assignments. Individuals from NPS APIS, NPS GLKN, USGS Upper Midwest Environmental Sciences Center, and NatureServe met to achieve the following objectives:

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

Project Boundary Extent

The APIS vegetation mapping project boundary extent consists of the entire APIS park boundary, 400 m of surface water jurisdiction into Lake Superior from mainland and island shorelines, plus an additional 400-m buffer landward (environs) beyond the APIS mainland boundary (Figure 11). The total map extent is 28,971.9 ha, including all the APIS lands, water jurisdiction, inholdings, and extended environs. The APIS comprises 28,074 ha (96.9%)[2] of the total map area (including the water jurisdiction), with the remaining 897.9 ha (3.1%) being environs. We produced a feature-class layer showing the extent of the project boundary and incorporated it into the APIS vegetation mapping project geodatabase.

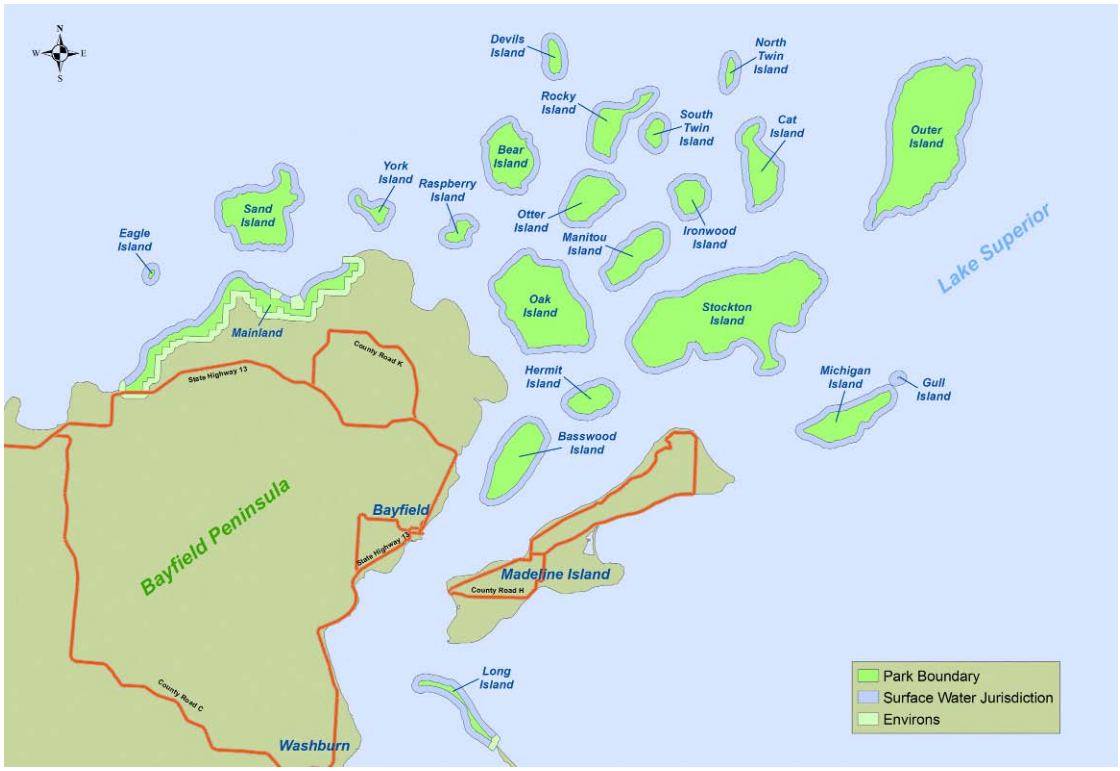


Figure 11. Project boundary for the Apostle Islands National Lakeshore vegetation mapping project.

[2] This reflects the area within the administrative boundary, of which 42 ha are private inholdings.

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 no single film emulsion serves all purposes. Our aim with collecting aerial photography for the APIS vegetation mapping project was to capture peak leaf-color change, aiding mapping in viewing distinctions between various deciduous forest types.

A set of 1:12,000-scale CIR aerial photographs was collected October 9, 2004 (funded by the NPS VIP, and the photo mission was supervised by GLKN staff). This set of photography covered the full project boundary extent and was the primary imagery used in photointerpretative mapping. Noteworthy, this set extends well beyond the project boundary extent into the Bayfield Peninsula. The aerial photographs were also orthoreferenced by the imagery contractor.

In addition to the CIR photos, a set of 1:24,000-scale TC aerial photographs were collected April 21, 2005, providing deciduous leaf-off viewing of the entire extent. This photo mission was part of a larger effort by Bayfield County, Wisconsin. Staff from the GLKN collaborated with Bayfield County to fund and expand the photo mission to include the APIS lands within Ashland County. Having the TC photos gave interpreters a definite advantage in determining evergreen tree and shrub components within forest communities that are 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 sets were produced for fieldwork use by mappers and vegetation crews. Diapositives of the CIR set were produced for photointerpretative mapping.

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

Table 4. Aerial photography sets for the Apostle Islands National Lakeshore vegetation mapping project.

[CIR, color-infrared; TC, true-color; APIS, Apostle Islands National Lakeshore]

Photography date	Film type	Scale	Photos	Products	Company
October 9, 2004	CIR Transparency (Positive)	1:12,000	539*	Contact Print Diapositive Orthophotograph	Great Lakes Aerial Survey, Inc. for Ayers Associates
April 21, 2005	TC Transparency (Positive)	1:24,000	655**	Contact Print Orthophotograph	Williams Aerial & Mapping, Inc.

*The CIR photography mission included an extended area of the Bayfield Peninsula, which was not included with the APIS vegetation mapping project. About 200 aerial photographs were actually used for the APIS vegetation mapping project.

**The TC photography mission included all of Bayfield County and the portion of Ashland County covering the APIS lands. Of the 655 aerial photographs, 177 were acquired for the APIS vegetation mapping project.

We produced a feature-class layer locating the centers of the CIR aerial photographs (1:12,000-scale) obtained in October 2004 (Figure 12). This feature class is incorporated into the APIS vegetation mapping project geodatabase. In addition, we produced digital orthophotographic mosaics of the CIR aerial photographs from October 2004

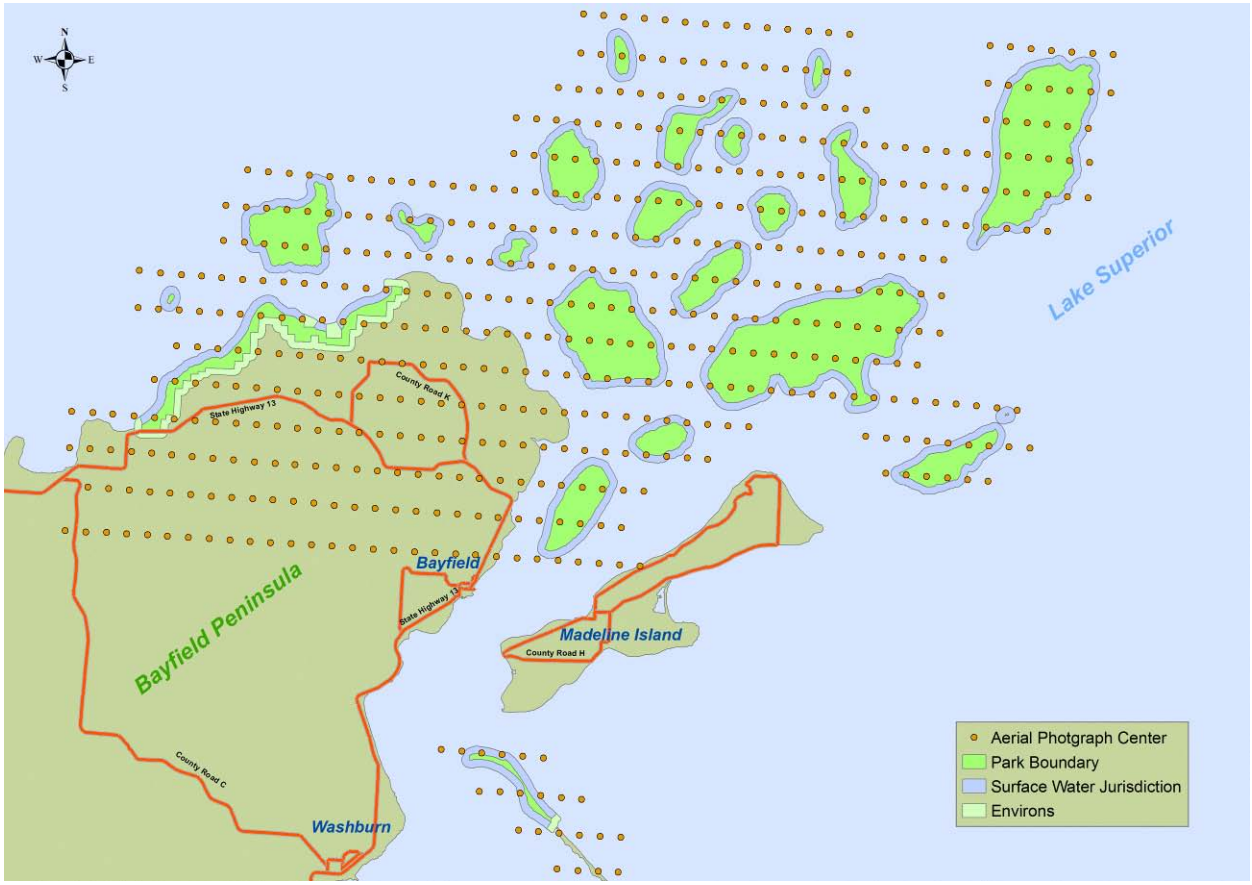


Figure 12. Centers of color-infrared aerial photographs (1:12,000-scale) obtained in October 2004 for the Apostle Islands National Lakeshore vegetation mapping project.

Minimum Mapping Units

We applied the NPS VIP standard minimum mapping unit (MMU) of 0.5 ha for mapping. For vegetation types unique to their immediate surroundings (e.g., emergent wetland within an upland-forest setting), we allowed for mapping below the MMU down to 0.25 ha; however, we purposely set an MMU of 0.25 ha for the mapping of two sparse vegetation map classes. In addition, we applied a secondary MMU standard of 2.0 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 APIS vegetation mapping project (e.g., the geodatabase), we organized the vegetation classification with the National Vegetation Classification Standard (NVCS), Version 2 (FGDC 2008). In the NVCS, separate 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 the classification 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 Apostle Islands National Lakeshore (APIS) was to prepare a preliminary classification report prior to vegetation sampling. This report for the APIS area was generated by reviewing all associations and alliances in the National Vegetation Classification Standard (NVCS) that are attributed to Minnesota, Wisconsin, Michigan, or Ontario in the Great Lakes Ecoregion (ECO48). This listing was derived by The Nature Conservancy (TNC), and covered a much broader area than the APIS project area, including many vegetation types that were very unlikely to occur there. The initial list of possible associations and alliances was reviewed by NatureServe and APIS staff to remove vegetation types thought unlikely to occur at the APIS. The resulting, preliminary classification report included 127 associations (NatureServe 2005a) 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) allow for the collection of approximately three plots per estimated vegetation type (from the preliminary classification report), on average. The preliminary classification listed 127 possible associations in the project area. Several of those were similar to each other, though, and we expected only one to actually be present in the project area. For example, we knew there would be *Typha*-dominated wetlands in the project area. There are three *Typha*-dominated associations that occur in the region near Lake Superior, and those three were 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 in only one. So, although we had three *Typha*-dominated marshes in the preliminary classification, we estimated that we would need only three plots to adequately characterize those marshes. We did this kind of analysis for all associations in the preliminary classification and estimated there would be approximately 62 unique vegetation associations at the APIS. Thus, our initial plan was to sample at least 186 plots.

Some vegetation types in the preliminary classification (e.g., pine forests on dunes, red oak-maple forests) were less well described or were expected to have variable composition from stand to stand, so we targeted them for 3–5 plots. Other types (e.g., cattail swamps, water-lily marshes) were well described and/or compositionally simpler; therefore, we targeted those for 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.

All sampling was done within the APIS boundary. Although the project area extends beyond the APIS boundary on the mainland, the great majority of the project extent is in NPS ownership, and the extended environs are mostly of private lands. Obtaining permission to work on private lands would have required significant planning and preparation, and we determined the added benefit of accessing these lands was low in comparison to the extensive lands with public access.

Our field team faced the problem of finding every vegetation type at the APIS 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 that this would allow the field crew to find as many different vegetation types as possible. They had three primary resources to help with this. These resources were as follows: (1) aerial photographs (October 2004, color-infrared, 1:12,000-scale) 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 since two adjacent stands may be floristically very similar but are separated in the NVCS based on physiognomic criteria (e.g., amount of shrub cover, which may be determined by one or two species).

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

Table 5. Plot sizes used for vegetation plot sampling for the Apostle Islands National Lakeshore vegetation mapping project.

Dominant physiognomy	Plot size	Plot area
Forest: trees have their crowns overlapping, usually forming 60-100% cover.	20 x 20 m or 40 x 10 m	400 m^2
Woodland: 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^2
Shrubland: 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^2
Dwarf-shrubland (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^2
Herbaceous (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^2
Nonvascular (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^2
Sparse vegetation (e.g., blowout, beach): less than 10% total vegetation cover.	10 x 10 m or 20 x 5 m	100 m^2

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.

Table 6. Cover classes and vegetation strata used during vegetation plot sampling for the Apostle Islands National Lakeshore 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 13 shows an example of a vegetation plot. For an example of a plot form, see Appendix A: Plot Sampling Form.



Figure 13. Example of a vegetation plot for the Apostle Islands National Lakeshore vegetation mapping project.

Sampling vegetation on the islands made for some necessary strategic planning. Boat travel and the scheduling thereof are customary at the APIS. The cost in both time and expense limited visits to islands, especially the more remote ones. Inclement weather conditions (high winds and waves) required field crews to adapt their plans with little advance notice. In addition, field

crews often would spend several days on one particular island for efficiency purposes, which added logistical problems and the need to transport extra equipment for island stays.

Data Analyses and Results

Field teams collected plot information from June through September 2005, sampling 114 plots. An additional 34 plots were sampled in the summer of 2006. The classification analyses were completed by using these 148 plots. After the initial classification had been completed, we noted that a few associations identified in the analyses were poorly described and represented by only one plot. In 2007, during our field reconnaissance for mapping, we sampled five more plots to provide additional data for some of these poorly sampled associations. Thus, a total of 153 plots were collected for classification development. We did not reach our goal of 186 plots, though we did end up with nearly an average of three plots per association.

The plots were located on 10 of the islands and the mainland unit (Figure 14). We did not make an effort to put plots on all the islands because of the substantial effort required to move field crews from island to island. We assumed that the vegetation on the 10 islands surveyed and the mainland unit was representative of vegetation throughout APIS, based on consultation with local experts. All field data were entered into the NPS PLOTS Database Version 2.0, a Microsoft Access database designed for the NPS VIP (NatureServe 2005b). 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).

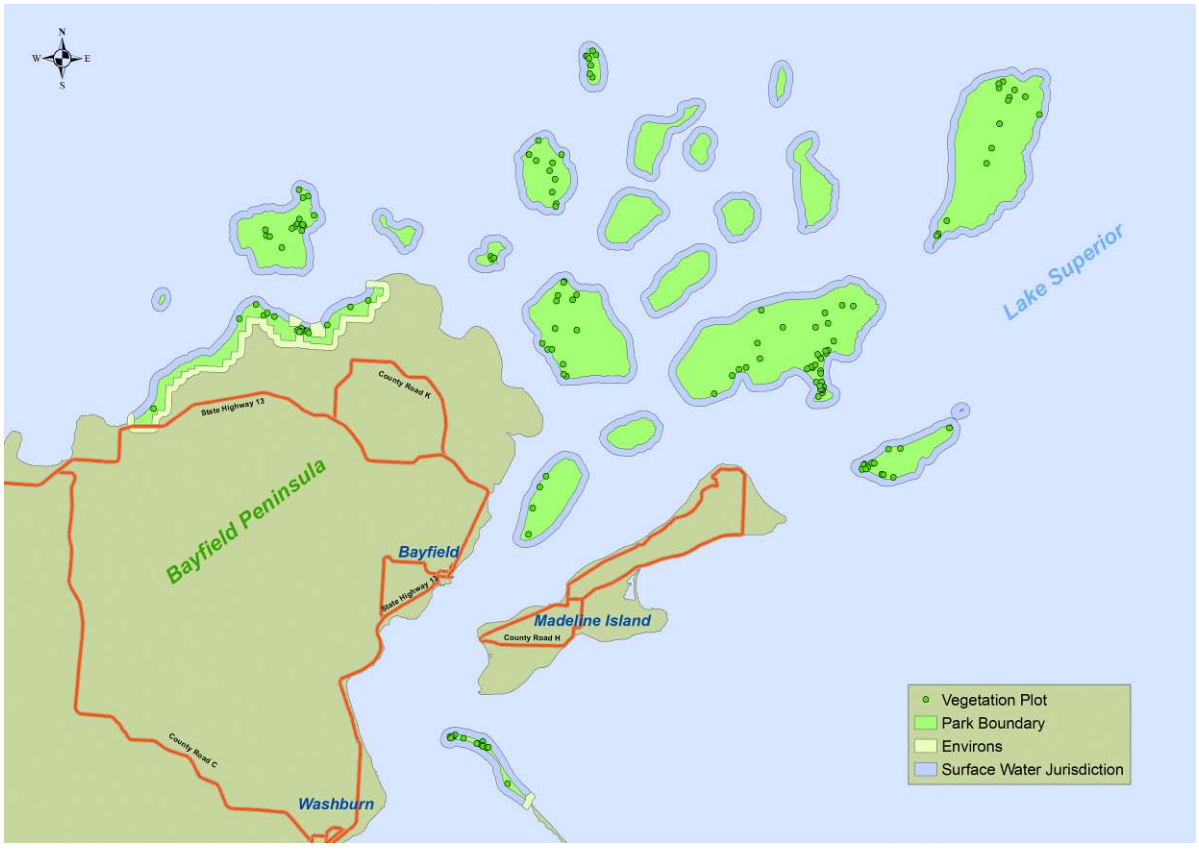


Figure 14. Locations of the 153 vegetation plots sampled for the Apostle Islands National Lakeshore vegetation mapping project.

Our 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. The initial groups were based on a distinction between wetland and upland plots (Figure 15). Subsequent groups were based on communities of significant woody canopy (forests, woodlands, and shrublands) versus herbaceous communities. The finest groups were based on abundance of individual species and formed the basis for identifying alliances and associations.

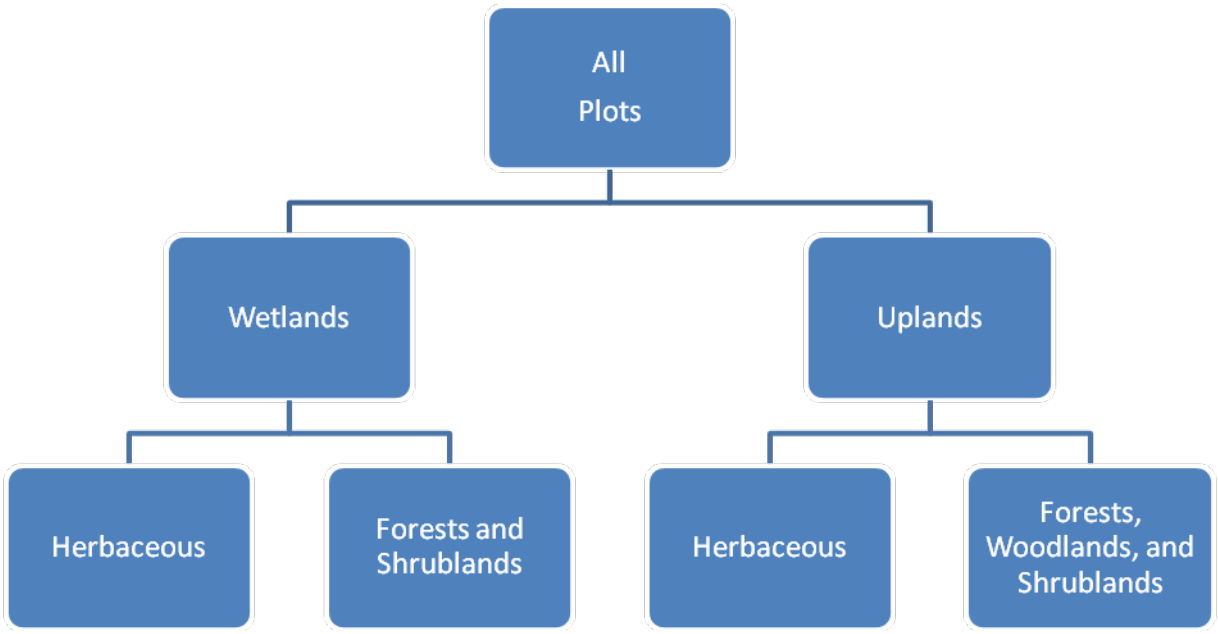


Figure 15. General vegetation groups as defined by cluster and ordination analyses for the vegetation classification of the Apostle Islands National Lakeshore.

Through the analyses of our summer 2006 sampling plots, we identified 38 plant communities (NVCS associations). During our summer 2007 field reconnaissance for the mapping effort, we discovered other communities that had not been characterized by the plot data. An additional 10 plant communities were defined from informal field data and aerial photo study, and the addition was eventually supported with data from field accuracy assessment (AA) collected in 2008. These communities were well described from a regional perspective, so assigning them to vegetation associations was fairly straightforward, even without full vegetation plots. The composition and location of these communities were often well known to the staff working on this project; therefore, some of the communities were classified based not only on quantitative information, but also on existing literature (Beals and Cottam 1960, Judziewicz et al. 1993), expert knowledge from the Wisconsin Natural Heritage Program, APIS staff, NatureServe ecologists, and field ecologists' observations in the field.

In all, a total of 48 natural/semi-natural associations from the NVCS were identified for APIS. Table 7 lists these associations and includes the number of times each type was sampled with a vegetation plot or an AA site. Note that the word "Placeholder" appears after two alliances, which indicates a weakly defined Alliance. It is also worth noting there were over four times as many AA sites sampled than vegetation plots (688 versus 153); most of the field observations were from AA sites. Data from AA sites provide important information on distribution and

dominant species but do not have the detail of a full vegetation plot. Also, four vegetation plots were not used in the classification, and seven AA sites were not assigned to any vegetation type. The unused data were collected in areas that were either too small or composed of mixtures of species not representing a distinct community (common to disturbed locations). The four plots were of two very small interdunal wetlands, a beaver-disturbed wetland, and an old field. The AA sites similarly represented transitional areas between two vegetation types or disturbed locations not fitting into a particular association in the classification.

Table 7. List of vegetation communities of Apostle Islands National Lakeshore, with number of field observations.

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

Group	Association Name	NVCS Code	Observations
Forest & Woodland			
Northern Hardwood - Hemlock - White Pine Forest Group			
	Maple - Yellow Birch Northern Hardwoods Forest	CEGL002457	55
	Northern Maple - Basswood Forest	CEGL002458	4
	Yellow Birch - (White Spruce) Forest	CEGL005245	6
	Great Lakes White Pine - Hemlock Forest	CEGL002590	5
	Aspen - Birch - Red Maple Forest	CEGL002467	8
	Aspen - Birch / Sugar Maple - Mixed Hardwoods Forest	CEGL002468	32
	Northern Red Oak - Sugar Maple Forest	CEGL002461	27
	White-cedar - Boreal Conifer Mesic Forest	CEGL002449	63
	Hemlock Mesic Forest	CEGL002598	23
	North-Central Hemlock - Hardwood Forest	CEGL005044	62
White Pine - Red Pine - Jack Pine - Oak Forest & Woodland Group			
	Jack Pine - Northern Pin Oak Forest	CEGL002478	5
	Red Pine - Aspen - Birch Forest	CEGL002520	7
	Red Pine / Blueberry Dry Forest	CEGL002443	11
	White Pine - Aspen - Birch Forest	CEGL002479	13
	White Pine / Mountain Maple Mesic Forest	CEGL002445	6
	White Pine / Blueberry Dry-Mesic Forest	CEGL002444	8
	Northern Pin Oak - (Bur Oak) Forest	CEGL002077	0
Great Lakes Pine Barrens Group			
	Great Lakes Dune Pine Forest	CEGL002589	9
Northern & Central Alkaline Conifer & Hardwood Swamp Group			
	Red Maple - Ash - Birch Swamp Forest	CEGL002071	14
	Black Ash - Mixed Hardwood Swamp	CEGL002105	20
	White-cedar - Black Ash Swamp	CEGL005165	3
	Hemlock - Yellow Birch Swamp Wet-Mesic Forest	CEGL005003	3
Northern & Central Shrub Swamp Group			
	Gray Alder Swamp Shrubland	CEGL002381	53
Jack Pine - Black Spruce Forest Group			
	Black Spruce / Feathermoss Forest	CEGL002447	6
	Jack Pine - Aspen / Bush-honeysuckle Forest	CEGL002518	0
	Jack Pine / Blueberry / Feathermoss Forest	CEGL002441	3
White Spruce - Balsam Fir Forest Group			
	Balsam Fir - Paper Birch Forest	CEGL002474	25
	Paper Birch / Fir Forest	CEGL002463	10
	Aspen - Birch / Boreal Conifer Forest	CEGL002466	40

Group	Association Name	NVCS Code	Observations
Black Spruce - Tamarack Acidic Swamp Group			
	Black Spruce - Tamarack / Labrador-tea Poor Swamp	CEGL005271	29
Tamarack - Conifer Alkaline Swamp Group			
	Northern Tamarack Rich Swamp	CEGL002471	8
	White-cedar - (Mixed Conifer) / Alder Swamp	CEGL002456	10
Shrubland & Grassland			
Great Lakes Coast Grassland & Shrubland Group			
	Great Lakes Beachgrass Dune	CEGL005098	36
	Great Lakes Beach-heather Dune Dwarf-shrubland	CEGL004024	3
	Great Lakes Juniper Dune Shrubland	CEGL005064	7
	Great Lakes Coast Pine Barrens	CEGL005125	12
Boreal Alkaline Peatland Group			
	Bog Birch - Willow Shore Fen	CEGL005227	24
	Wiregrass Sedge Shore Fen	CEGL005229	4
North American Boreal Acidic Peatland Group			
	Leatherleaf - Sweetgale Shore Fen	CEGL005228	24
	Leatherleaf Poor Fen	CEGL005277	24
Eastern North American Wet Meadow Group			
	Bluejoint Wet Meadow	CEGL005174	17
	Northern Sedge Wet Meadow	CEGL002257	25
Herbaceous Forested Seep Group			
	Clay Seeps	CEGL005163	1
Aquatic Vegetation			
Eastern North American Freshwater Aquatic Vegetation Group [Placeholder]			
	Northern Water-lily Aquatic Wetland	CEGL002562	3
	Midwest Pondweed Submerged Aquatic Wetland	CEGL002282	3
Nonvascular & Sparse Vascular Rock Vegetation			
Eastern North American Lake & River Bluff Group [Placeholder]			
	Eroding Clay Bank	CEGL002584	22
Great Lakes Cliff & Shore Group [Placeholder]			
	Great Lakes Sandstone Bedrock Shore	CEGL002507	8
	Great Lakes Shore Sandstone Cliff	CEGL002503	5

For NVCS types above the association level (e.g., group), 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 APIS 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 APIS is a combination of small to large islands and a mainland unit, and the plant communities reflected these variable environments throughout APIS. In addition to physiognomy and species, grouping plots into classification units was influenced by position and size of islands along with historical land use on those islands. Similar communities may change slightly from island to island, and an expression of a given community on one island may be slightly different than those on another island. The northern hardwood forest type, dominated by sugar maple (*Acer saccharum*) and other hardwood species, is the most common plant community throughout APIS. The species within that community change slightly from island to island and between the islands and the mainland. For example, yellow birch (*Betula alleghaniensis*) is often replaced by paper birch (*Betula papyrifera*). Likewise, disturbances on some islands (either from natural wind or human activities) change the character of this community as well. The variability within this community sometimes made it difficult to separate it from other communities dominated by a species that may be present as a minor element in northern hardwood forest stands but were more indicative of another community type.

Our goal was to sample all of the vegetation communities during the plot sampling phase of the project. From experience with other vegetation classification and mapping projects, we know this is rarely, if ever, achieved. Field crews were not able to canvas the entire park during the approximately 15 weeks of field time they had. The mappers' field reconnaissance and accuracy assessment phases of the project included approximately 24 weeks of field crew time. This additional field time, along with the aerial photointerpretation of the entire park landscape, resulted in discovering 10 additional plant communities at the APIS. All but one of these fit into existing associations that are well described on a regional basis. This gave us adequate information about the composition of the association to match with what was observed at the APIS and assign the associations. There were also sites located on beach dunes dominated by wooly beach-heather (*Hudsonia tomentosa*) that did not fit an existing association. A new association—Great Lakes Beach-heather Dune Dwarf-shrubland—was created to account for this vegetation type.

There are several unique communities on individual islands not found elsewhere within APIS. For example, Long Island is the only location where inland Jack pine (*Pinus banksiana*) and northern pin oak (*Quercus ellipsoidalis*) communities occur (Figure 16). Devils Island is unique in that it contains many subboreal and boreal communities such as those dominated by white spruce (*Picea glauca*) and balsam fir (*Abies balsamea*). One of the most unique areas found within APIS is the tombolo on Stockton Island. This is a mosaic of upland and wetland communities found on a very thin, narrow sand spit. Both the placing of sampling plots and the classifying of those plots was a challenge given the intertwining of many small but important communities found within such as small area.



Figure 16. Unique community of jack pine and northern pin oak on Long Island, Apostle Islands National Lakeshore.

Vegetation Mapping

Methods

Mapping vegetation of Apostle Islands National Lakeshore (APIS) and environs involved five primary steps: (1) preliminary map classification (2) field reconnaissance, (3) map classification, (4) photointerpretation, and (5) 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 it 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 APIS 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 2007 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 invested several days in the field investigating ground conditions with aerial photographs in hand. This process is necessary, as Hershey and Befort (1995) explain, because color-infrared (CIR) photography is not consistent 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. 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 (Figure 17). Field reconnaissance also allowed photointerpreters to become more familiar with the local ecology of plant communities, which is always important when applying ecologic concepts to photointerpretative mapping. Where photointerpreters discovered limitations to interpreting vegetation types by using aerial photographs, environmental models were tested (e.g., soil, aspect) to determine if vegetation types could be consistently separated by environmental elements.



Figure 17. Field reconnaissance to correlate aerial photo signatures to ground vegetation for the Apostle Islands National Lakeshore vegetation mapping project.

We performed our field reconnaissance throughout the summer of 2007. Much of this effort was accomplished as 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. 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.

The photo contact prints were taken into the field, with notes recorded 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 would build 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 associations 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 activities). For those map classes, we assigned the appropriate type further up the hierarchy (e.g., group) within the NVCS. Cultural vegetation (e.g., roads, residence, parks) were 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)[3]. For non-vegetated features (e.g., open water bodies), we derived map classes corresponding closely with the classification from NLCD 2001.

[3] The NLCD 2001 is a land cover database produced by the Multi-Resolution Land Characterization 2001 Consortium.

For those map classes representing associations in the NVCS, we used the synonym names as established by in the classification database of NatureServe[4] (e.g., Great Lakes White Pine - Hemlock Forest) from their database. For map classes with phases, we used the synonym names, followed by, and in parenthesis, the phase name we derived, such as Great Lakes Coast Pine Barrens (barrens 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 ecological interests. For map classes representing types above the floristic level in the NVCS and for non-vegetated features, we derived generic names to describe the feature.

We continually updated the map classification throughout the mapping effort. Each field endeavor revealed new information, prompting us to modify map classes and their definitions. We also made revisions as the vegetation classification developed to completeness. Furthermore, as aerial photos were interpreted, new issues arose, which forced us to redefine, expand, or polish map-class definitions. 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 the following two sections: (1) a single map-class code and (2) a set of physiognomic modifier codes. A hyphen separates the two code systems (e.g., [map-class code]-[set of physiognomic modifier 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 the APIS.

[4] One map class, Alder - Willow Shore Fen (SAW), was renamed differently than the synonym name for the given association in the NVCS. The true synonym name is Bog Birch - Willow Shore Fen.

Table 8. Physiognomic modifiers assigned to polygons during photointerpretation for the Apostle Islands National Lakeshore 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

An example of a map attribute code is "FCM-1A3." This code describes given map polygons as the conifer - hardwood phase (FCM) of the map class White-cedar - Boreal Conifer Mesic Forest, 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 throughout the mapped polygon. 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 mapping overlays to the CIR aerial photos (1:12,000-scale) from October 2004 by using the fiducials (standard reference points) and photo-identification information. We viewed the CIR aerial photos 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 0.5 ha between map classes and a MMU of 2.0 ha between physiognomic modifiers within a map-class unit. Exceptions for mapping below the MMU (down to 0.25 ha) were allowed for map-class units with vegetation unique to the immediate surroundings (e.g., herbaceous wetland within an upland forest)[5]. We did, however, purposely set an MMU of 0.25 ha for the mapping of two sparse vegetation types. Interpreted data—map polygons and attributes—were applied to photo overlays covering the CIR photos. True-color aerial photos (1:24,000-scale) from April 2005 were viewed digitally on computer

[5] It should also be noted that we allowed polygons as low as 0.1 ha once clipped by the project boundary.

and/or by using a Topcon (MS-3) mirror stereoscope with 3x binocular stereoscopes to aid the interpretation of the CIR photos.

Each diapositive photo was paired with the adjacent photo (stereo pair) so we could view the images three-dimensionally. We delineated features and scribed 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). We applied standard photo signature characteristics, 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 to 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. A second photointerpreter reviewed the interpreted work for quality.

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), Zone 15, 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[6].

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 had only map-attribute codes assigned to each polygon. To assign meaningful information to each polygon (e.g., map-class names, physiognomic definitions, links 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 linked the map to other feature-class layers produced from this project, including vegetation sample plots, accuracy assessment (AA) sites, aerial photo locations, and 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.

[6] We also produced an orthophoto mosaic of the entire APIS vegetation mapping project from the individually orthorectified color-infrared images from October 2004, distributed as a final product.

Results

Map Classes

We developed 63 map classes (including map-class phases) to map the APIS and environs. Of these 63 map classes, 58 represent natural/semi-natural vegetation types within the NVCS, one represents a cultural vegetation type (developed) within the NVCS, and four represent non-vegetated units (open water, barren land). Table 9 provides a breakdown of these map classes in regards to the finer levels of the NVCS, including the following: floristic (association), group, and macrogroup. The units not included in the NVCS are listed as well. Explanations to each unit are provided after the table.

Table 9. Map class distribution within the National Vegetation Classification Standard for the Apostle Islands National Lakeshore vegetation mapping project.

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

NVCS Classes	Map Class	Floristic	Group	Macrogroup
FOREST & WOODLAND	38	32	11	7
SHRUBLAND & GRASSLAND	15	11	6	4
AQUATIC VEGETATION	2	2	1	1
NONVASCULAR & SPARSE VASCULAR ROCK VEGETATION	3	3	2	1
DEVELOPED VEGETATION CULTURAL	1	n/a	n/a	n/a
NVCS Total	**59**	**48***	**20***	**13**

Non-NVCS Units (NLCD 2001)	Map Class
Open Water	3
Barren Land	1
Non-NVCS Total	**4**
Map Class Grand Total	**63**

*One of the 48 associations (and one of the 20 groups) designated for this project was not captured directly by any one map class—Clay Seeps Sparse Vegetation Association of the Herbaceous Forested Seep Group (CEGL005163, G189). These seeps were too small to map.

Map Classes in the NVCS

Fifty-eight map classes represent natural/semi-natural types in the NVCS, and one represents a cultural type (developed area, which is modified into further detail by using NLCD 2001 classes). Seven map classes rest at the group level within the NVC Standard. Fifty-one map classes represent 47 association types in the NVCS (one association is not captured directly by any one map class), of which eight of these classes are phases within four association types. The following is a breakdown of map classes and their relation to the NVCS, organized by NVCS class.

Forest & Woodland: Thirty-eight map classes represent 34 natural/semi-natural vegetation types. Three map classes rest at two group types, one being a ruderal forest group and one being a plantation group. Thirty-five map classes represent 32 association types; six of these map classes are phases within three of the associations.

Shrubland & Grassland: Fifteen map classes represent 12 natural/semi-natural vegetation types. Four map classes rest at two group types, three being ruderal and one being wet meadow. Eleven

map classes represent 10 associations; two of these map classes are phases within one association.

It is worth noting that one association type (as well as one group type) was not captured directly by any one map class—Clay Seeps Sparse Vegetation Association of the Herbaceous Forested Seep Group (CEGL005163, G189). These seeps were too small to map. This type is believed to be most common as an inclusion to the map class Eroding Clay Bank, which represents the Eroding Clay Bank Sparse Vegetation Association (CEGL002584).

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

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

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

Map Classes Not in the NVCS

Four map classes represent non-vegetation features not described in the NVCS, which correlate to the NLCD 2001 classification. We have categorized these map classes into the two following groups: Non-vegetated Water and Non-vegetated Land.

Map Classification Link to Types in the NVCS

Table 10 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 possible of the NVCS.

Table 10. Map classification with crosswalk to the National Vegetation Classification Standard (Version 2) for the Apostle Islands National Lakeshore vegetation mapping project.

[NVCS, National Vegetation Classification Standard; NLCD, National Land Cover Database; MMU, minimum mapping unit]

Map-class Code	Map-class Name
1. FOREST & WOODLAND CLASS	
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	
Acer saccharum - *Betula alleghaniensis* - (*Tilia americana*) Forest Association (CEGL002457)	
FMB	Maple - Yellow Birch Northern Hardwoods Forest
Acer saccharum - *Tilia americana* / *Ostrya virginiana* / *Lonicera canadensis* Forest Association (CEGL002458)	
FMT	Northern Maple - Basswood Forest
Betula alleghaniensis - (*Acer saccharum*, *Picea glauca*) Forest [Provisional] Association (CEGL005245)	
FYB	Yellow Birch - (White Spruce) Forest
Pinus strobus - *Tsuga canadensis* Great Lakes Forest Association (CEGL002590)	
FWH	Great Lakes White Pine - Hemlock Forest
Populus tremuloides - *Betula papyrifera* - (*Acer rubrum*, *Populus grandidentata*) Forest Association (CEGL002467)	
FBR	Aspen - Birch - Red Maple Forest
Populus tremuloides - *Betula papyrifera* / *Acer saccharum* - Mixed Hardwoods Forest Association (CEGL002468)	
FAM	Aspen - Birch / Sugar Maple - Mixed Hardwoods Forest
Quercus rubra - *Acer saccharum* - (*Betula alleghaniensis*)Forest Association (CEGL002461)	
FOM	Northern Red Oak - Sugar Maple Forest
Thuja occidentalis / *Abies balsamea* - *Acer spicatum* Forest Association (CEGL002449)	
FCC	White-cedar - Boreal Conifer Mesic Forest (conifer phase)
FCM	White-cedar - Boreal Conifer Mesic Forest (conifer - hardwood phase)
Tsuga canadensis - (*Betula alleghaniensis*) Forest Association (CEGL002598)	
FHC	Hemlock Mesic Forest
Tsuga canadensis - *Acer saccharum* - *Betula alleghaniensis* Forest Association (CEGL005044)	
FHM	North-Central Hemlock - Hardwood Forest

Map-class Code	Map-class Name
	G025. White Pine - Red Pine - Jack Pine - Oak Forest & Woodland Group
	Pinus banksiana - (*Pinus resinosa*) - *Quercus ellipsoidalis* / *Carex pensylvanica* Forest Association (CEGL002478)
FJO	Jack Pine - Northern Pin Oak Forest
	Pinus resinosa - *Populus tremuloides* / *Diervilla lonicera* - *Vaccinium* spp. Forest Association (CEGL002520)
FRA	Red Pine - Aspen - Birch Forest
	Pinus resinosa / *Vaccinium* spp. Forest Association (CEGL002443)
FRP	Red Pine / Blueberry Dry Forest
	Pinus strobus - *Populus tremuloides* / *Corylus cornuta* Forest Association (CEGL002479)
FWA	White Pine - Aspen - Birch Forest
	Pinus strobus / *Acer spicatum* - *Corylus cornuta* Forest Association (CEGL002445)
FWM	White Pine / Mountain Maple Mesic Forest
	Pinus strobus / *Vaccinium* spp. Forest Association (CEGL002444)
FWP	White Pine / Blueberry Dry-Mesic Forest
	Quercus ellipsoidalis - *(Quercus macrocarpa)* Forest Association (CEGL002077)
FPO	Northern Pin Oak - (Bur Oak) Forest
	MG159. Northern Pine - Oak Woodland & Barrens Macrogroup
	G160. Great Lakes Pine Barrens Group
	Pinus banksiana - *Pinus resinosa* - *Pinus strobus* Dune Forest Association (CEGL002589)
FPD	Great Lakes Dune Pine Forest
	MG013. Eastern North American Ruderal Forest & Plantation Macrogroup
	G030. Northern & Central Hardwood & Conifer Ruderal Forest Group
FDX	Hardwood Ruderal Forest
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
	Acer rubrum - *Fraxinus* spp. - *Betula papyrifera* / *Cornus canadensis* Forest Association (CEGL002071)
FRM	Red Maple - Ash - Birch Swamp Forest

Map-class Code	Map-class Name
	Fraxinus nigra - Mixed Hardwoods - Conifers / *Cornus sericea* / *Carex* spp. Forest Association (CEGL002105)
FBA	Black Ash - Mixed Hardwood Swamp
	Thuja occidentalis - *Fraxinus nigra* Forest Association (CEGL005165)
FCA	White-cedar - Black Ash Swamp
	Tsuga canadensis - *Betula alleghaniensis* Saturated Forest Association (CEGL005003)
FHS	Hemlock - Yellow Birch Swamp Wet-Mesic Forest
MG160. Northern & Central Tall Shrub Wetland Macrogroup	
G167. Northern & Central Shrub Swamp Group	
	Alnus incana Swamp Shrubland Association (CEGL002381)
SAS	Gray Alder Swamp Shrubland
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	
	Picea mariana / *Pleurozium schreberi* Forest Association (CEGL002447)
FBS	Black Spruce / Feathermoss Forest
	Pinus banksiana - *Populus tremuloides* / *Diervilla lonicera* Forest Association (CEGL002518)
FJM	Jack Pine - Aspen / Bush-honeysuckle Forest
	Pinus banksiana / *Vaccinium* spp. / *Pleurozium schreberi* Forest Association (CEGL002441)
FJB	Jack Pine / Blueberry / Feathermoss Forest
G048. White Spruce - Balsam Fir Forest Group	
	Abies balsamea - *Betula papyrifera* / *Diervilla lonicera* Forest Association (CEGL002474)
FBF	Balsam Fir - Paper Birch Forest (conifer phase)
FFB	Balsam Fir - Paper Birch Forest (conifer - hardwood phase)
	Betula papyrifera / *Diervilla lonicera* - (*Abies balsamea*) Forest Association (CEGL002463)
FPB	Paper Birch / Fir Forest
	Populus tremuloides - *Betula papyrifera* / (*Abies balsamea*, *Picea glauca*) Forest Association (CEGL002466)
FAC	Aspen - Birch / Boreal Conifer Forest

Map-class Code	Map-class Name
	1.D.2.a. North American Boreal Flooded & Swamp Forest Division
	MG038. Central & Eastern Boreal Flooded & Swamp Forest Macrogroup
	G050. Black Spruce - Tamarack Acidic Swamp Group
	Picea mariana - (*Larix laricina*) / *Ledum groenlandicum* / *Sphagnum* spp. Forest Association (CEGL005271)
FSS	Black Spruce - Tamarack / Labrador-tea Poor Swamp (black spruce phase)
FTP	Black Spruce - Tamarack / Labrador-tea Poor Swamp (tamarack phase)
	G051. Tamarack - Conifer Alkaline Swamp Group
	Larix laricina / *Alnus incana* Forest Association (CEGL002471)
FTR	Northern Tamarack Rich Swamp
	Thuja occidentalis - (*Picea mariana*, *Abies balsamea*) / *Alnus incana* Forest Association (CEGL002456)
FCS	White-cedar - (Mixed Conifer) / Alder Swamp
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
SMX	Conifer - Deciduous Ruderal Shrubland
HMX	Ruderal Grassland
	2.C.3.a. Eastern North American Coastal Grassland & Shrubland Division
	MG057. Eastern North American Coastal Grassland & Shrubland Macrogroup
	G089. Great Lakes Coast Grassland & Shrubland Group
	Ammophila breviligulata - (*Schizachyrium scoparium*) Herbaceous Vegetation Association (CEGL005098)
HAB	Great Lakes Beachgrass Dune
	Hudsonia tomentosa Dune Dwarf-shrubland Association (CEGL004024)
DBH	Great Lakes Beach-heather Dune Dwarf-shrubland
	Juniperus horizontalis - *Arctostaphylos uva-ursi* - *Juniperus communis* Dune Dwarf-shrubland Association (CEGL005064)
DJD	Great Lakes Juniper Dune Shrubland
	Pinus banksiana - (*Pinus resinosa*) - *Pinus strobus* / *Juniperus horizontalis* Wooded Herbaceous Vegetation Association (CEGL005125)
HPB	Great Lakes Coast Pine Barrens (barrens phase)
HPW	Great Lakes Coast Pine Barrens (woodland phase)

Map-class Code	Map-class Name
	2.C.4.a. North American Bog & Fen Division
	MG062. North American Boreal Bog & Fen Macrogroup
	G185. Boreal Alkaline Peatland Group
	Alnus incana - *Salix* spp. - *Betula pumila* / *Chamaedaphne calyculata* Shrubland Association (CEGL005227)
SAW	Alder - Willow Shore Fen
	Carex lasiocarpa - (*Carex rostrata*) - *Equisetum fluviatile* Herbaceous Vegetation Association (CEGL005229)
HSS	Wiregrass Sedge Shore Fen
	G053. North American Boreal Acidic Peatland Group
	Chamaedaphne calyculata - *Myrica gale* / *Carex lasiocarpa* Dwarf-shrubland Association (CEGL005228)
DLS	Leatherleaf - Sweetgale Shore Fen
	Chamaedaphne calyculata / *Carex oligosperma* / *Sphagnum* spp. Poor Fen Dwarf-shrubland Association (CEGL005277)
DLF	Leatherleaf Poor Fen
	2.C.5.a. Eastern North America Freshwater Wet Meadow, Riparian & Marsh Division
	MG069. Eastern & North-Central North American Marsh & Wet Meadow Macrogroup
	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
	G189. Herbaceous Forested Seep Group
	Clay Seeps Sparse Vegetation Association (CEGL005163)
N/A	Clay Seeps
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 & Rock Vegetation Division	
MG111. Eastern North American Cliff & Rock Vegetation Macrogroup	
G340. Eastern North American Lake & River Bluff Group [Placeholder]	
Eroding Clay Bank Sparse Vegetation Association (CEGL002584)	
VEB	Eroding Clay Bank
G341. Great Lakes Cliff & Shore Group [Placeholder]	
Sandstone Bedrock Great Lakes Shore Sparse Vegetation Association (CEGL002507)	
VBS*	Great Lakes Sandstone Bedrock Shore
Sandstone Great Lakes Shore Cliff Sparse Vegetation Association (CEGL002503)	
VSC*	Great Lakes Shore Sandstone Cliff
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 (<1% vegetated)	
Non-Vegetated Water	
Open Water (NLCD 2001; 11)	
NSR	Stream & River
NWP	Open Water Pond
NWL	Open Water Lake
Non-Vegetated Land	
Barren Land (NLCD 2001; 31)	
NSB	Sand & Cobble Beach

*Mapped to a non-standard MMU of 0.25 ha.

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 11 provides a summary report of the spatial-data layer (map) of APIS and summarizes frequency, area, and average polygon size for each map class (including phases). Table 12 provides a summary report with map classes compiled at the group level within the NVCS. These summary reports organize the map classes by hierarchy within 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 11. Frequencies and areas of map classes (organized via the National Vegetation Classification Standard) represented in the vegetation map layer for the Apostle Islands National Lakeshore 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)
FOREST & WOODLAND CLASS						
Northern Hardwood - Hemlock - White Pine Forest Group						
FMB	Maple - Yellow Birch Northern Hardwoods Forest	1,344	11,201.7	8.3	27,680.1	20.6
FMT	Northern Maple - Basswood Forest	1	1.4	1.4	3.6	3.6
FYB	Yellow Birch - (White Spruce) Forest	1	1.8	1.8	4.3	4.3
FWH	Great Lakes White Pine - Hemlock Forest	9	5.7	0.6	14.0	1.6
FBR	Aspen - Birch - Red Maple Forest	22	11.7	0.5	29.0	1.3
FAM	Aspen - Birch / Sugar Maple - Mixed Hardwoods Forest	143	340.5	2.4	841.3	5.9
FOM	Northern Red Oak - Sugar Maple Forest	324	438.4	1.4	1,083.2	3.3
FCC	White-cedar - Boreal Conifer Mesic Forest (conifer phase)	137	95.4	0.7	235.7	1.7
FCM	White-cedar - Boreal Conifer Mesic Forest (conifer - hardwood phase)	575	2,218.1	3.9	5,481.1	9.5
FHC	Hemlock Mesic Forest	66	45.6	0.7	112.7	1.7
FHM	North-Central Hemlock - Hardwood Forest	635	1,301.7	2.0	3,216.5	5.1
White Pine - Red Pine - Jack Pine - Oak Forest & Woodland Group						
FJO	Jack Pine - Northern Pin Oak Forest	7	4.9	0.7	12.2	1.7
FRA	Red Pine - Aspen - Birch Forest	4	2.3	0.6	5.6	1.4
FRP	Red Pine / Blueberry Dry Forest	15	18.6	1.2	45.9	3.1
FWA	White Pine - Aspen - Birch Forest	118	139.4	1.2	344.5	2.9
FWM	White Pine / Mountain Maple Mesic Forest	2	0.7	0.3	1.6	0.8
FWP	White Pine / Blueberry Dry-Mesic Forest	18	16.4	0.9	40.5	2.3
FPO	Northern Pin Oak - (Bur Oak) Forest	2	2.6	1.3	6.4	3.2
Great Lakes Pine Barrens Group						
FPD	Great Lakes Dune Pine Forest	5	2.7	0.5	6.7	1.3
Northern & Central Hardwood & Conifer Ruderal Forest Group						
FDX	Hardwood Ruderal Forest	14	58.9	4.2	145.5	10.4
FMX	Conifer - Hardwood Ruderal Forest	29	38.1	1.3	94.1	3.2

Map Code	Map-class Name	Freq	Area (Ha)	Ave (Ha)	Area (Ac)	Ave (Ac)
Northern & Central Conifer & Hardwood Plantation Group						
FPE	Conifer Plantation	1	3.3	3.3	8.2	8.2
Northern & Central Alkaline Conifer & Hardwood Swamp Group						
FRM	Red Maple - Ash - Birch Swamp Forest	83	58.6	0.7	144.9	1.7
FBA	Black Ash - Mixed Hardwood Swamp	64	118.0	1.8	291.6	4.6
FCA	White-cedar - Black Ash Swamp	17	14.0	0.8	34.5	2.0
FHS	Hemlock - Yellow Birch Swamp Wet-Mesic Forest	23	28.4	1.2	70.1	3.0
Northern & Central Shrub Swamp Group						
SAS	Gray Alder Swamp Shrubland	63	81.3	1.3	200.8	3.2
Jack Pine - Black Spruce Forest Group						
FBS	Black Spruce / Feathermoss Forest	11	9.1	0.8	22.4	2.0
FJM	Jack Pine - Aspen / Bush-honeysuckle Forest	3	2.6	0.9	6.4	2.1
FJB	Jack Pine / Blueberry / Feathermoss Forest	8	8.5	1.1	20.9	2.6
White Spruce - Balsam Fir Forest Group						
FBF	Balsam Fir - Paper Birch Forest (conifer phase)	83	85.7	1.0	211.6	2.5
FFB	Balsam Fir - Paper Birch Forest (conifer - hardwood phase)	234	355.8	1.5	879.2	3.8
FPB	Paper Birch / Fir Forest	24	22.7	0.9	56.2	2.3
FAC	Aspen - Birch / Boreal Conifer Forest	29	75.6	2.6	186.8	6.4
Black Spruce - Tamarack Acidic Swamp Group						
FSS	Black Spruce - Tamarack / Labrador-tea Poor Swamp (black spruce phase)	41	119.4	2.9	295.0	7.2
FTP	Black Spruce - Tamarack / Labrador-tea Poor Swamp (tamarack phase)	18	36.6	2.0	90.6	5.0
Tamarack - Conifer Alkaline Swamp Group						
FTR	Northern Tamarack Rich Swamp	7	8.1	1.2	19.9	2.8
FCS	White-cedar - (Mixed Conifer) / Alder Swamp	26	32.1	1.2	79.3	3.0
SHRUBLAND & GRASSLAND CLASS						
Eastern Ruderal Shrubland & Grassland Group						
SDX	Deciduous Ruderal Shrubland	37	46.9	1.3	115.8	3.1
SMX	Conifer - Deciduous Ruderal Shrubland	11	5.7	0.5	14.1	1.3
HMX	Ruderal Grassland	17	14.9	0.9	36.8	2.2

Map Code	Map-class Name	Freq	Area (Ha)	Ave (Ha)	Area (Ac)	Ave (Ac)
Great Lakes Coast Grassland & Shrubland Group						
HAB	Great Lakes Beachgrass Dune	38	73.7	1.9	182.2	4.8
DBH	Great Lakes Beach-heather Dune Dwarf-shrubland	4	1.6	0.4	4.0	1.0
DJD	Great Lakes Juniper Dune Shrubland	11	9.0	0.8	22.3	2.0
HPB	Great Lakes Coast Pine Barrens (barrens phase)	4	4.5	1.1	11.2	2.8
HPW	Great Lakes Coast Pine Barrens (woodland phase)	12	11.7	1.0	28.9	2.4
Boreal Alkaline Peatland Group						
SAW	Alder - Willow Shore Fen	41	46.8	1.1	115.5	2.8
HSS	Wiregrass Sedge Shore Fen	13	11.5	0.9	28.3	2.2
North American Boreal Acidic Peatland Group						
DLS	Leatherleaf - Sweetgale Shore Fen	67	118.7	1.8	293.4	4.4
DLF	Leatherleaf Poor Fen	9	43.8	4.9	108.3	12.0
Eastern North American Wet Meadow Group						
HWM	Wet Meadow Mixed Herbaceous	78	74.6	1.0	184.3	2.4
HCC	Bluejoint Wet Meadow	10	4.3	0.4	10.7	1.1
HSG	Northern Sedge Wet Meadow	66	47.4	0.7	117.2	1.8
Herbaceous Forested Seep Group						
N/A	Clay Seeps	0	0.0	0.0	0.0	0.0
AQUATIC VEGETATION CLASS						
Eastern North American Freshwater Aquatic Vegetation Group						
HFA	Northern Water-lily Aquatic Wetland	15	15.3	1.0	37.8	2.5
HSV	Midwest Pondweed Submerged Aquatic Wetland	28	18.2	0.6	44.9	1.6
NONVASCULAR & SPARSE VASCULAR ROCK VEGETATION CLASS						
Eastern North American Lake & River Bluff Group						
VEB	Eroding Clay Bank	30	32.2	1.1	79.7	2.7
Great Lakes Cliff & Shore Group						
VBS	Great Lakes Sandstone Bedrock Shore	22	10.0	0.5	24.8	1.1
VSC	Great Lakes Shore Sandstone Cliff	13	4.0	0.3	10.0	0.8

Map Code	Map-class Name	Freq	Area (Ha)	Ave (Ha)	Area (Ac)	Ave (Ac)
DEVELOPED VEGETATION CULTURAL CLASS						
Developed Area						
NDV	Developed Area	46	54.2	1.2	133.9	2.9
NON-NVCS UNITS						
Open Water						
NSR	Stream & River	3	1.2	0.4	3.0	1.0
NWP	Open Water Pond	1	0.6	0.6	1.4	1.4
NWL	Open Water Lake	23	11,267.5	489.9	27,842.6	1,210.5
Barren Land						
NSB	Sand & Cobble Beach	57	47.5	0.8	117.3	2.1

Table 12. 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 Apostle Islands National Lakeshore vegetation mapping project.

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

NVCS Class and Group Name	Freq	Area (Ha)	Ave (Ha)	Area (Ac)	Ave (Ac)
FOREST & WOODLAND CLASS	**4,206**	**17,006.0**	**4.0**	**42,022.9**	**10.0**
Northern Hardwood - Hemlock - White Pine Forest Group	3,257	15,661.9	4.8	38,701.5	11.9
White Pine - Red Pine - Jack Pine - Oak Forest & Woodland Group	166	184.8	1.1	456.7	2.8
Great Lakes Pine Barrens Group	5	2.7	0.5	6.7	1.3
Northern & Central Hardwood & Conifer Ruderal Forest Group	43	97.0	2.3	239.6	5.6
Northern & Central Conifer & Hardwood Plantation Group	1	3.3	3.3	8.2	8.2
Northern & Central Alkaline Conifer & Hardwood Swamp Group	187	219.0	1.2	541.1	2.9
Northern & Central Shrub Swamp Group	63	81.3	1.3	200.8	3.2
Jack Pine - Black Spruce Forest Group	22	20.1	0.9	49.7	2.3
White Spruce - Balsam Fir Forest Group	370	539.8	1.5	1,333.8	3.6
Black Spruce - Tamarack Acidic Swamp Group	59	156.0	2.6	385.6	6.5
Tamarack - Conifer Alkaline Swamp Group	33	40.1	1.2	99.2	3.0

NVCS Class and Group Name	Freq	Area (Ha)	Ave (Ha)	Area (Ac)	Ave (Ac)
SHRUBLAND & GRASSLAND CLASS	**418**	**515.1**	**1.2**	**1,272.9**	**3.0**
Eastern Ruderal Shrubland & Grassland Group	65	67.4	1.0	166.6	2.6
Great Lakes Coast Grassland & Shrubland Group	69	100.6	1.5	248.5	3.6
Boreal Alkaline Peatland Group	54	58.2	1.1	143.9	2.7
North American Boreal Acidic Peatland Group	76	162.5	2.1	401.6	5.3
Eastern North American Wet Meadow Group	154	126.3	0.8	312.2	2.0
Herbaceous Forested Seep Group	0	0.0	0.0	0.0	0.0
AQUATIC VEGETATION CLASS	**43**	**33.5**	**0.8**	**82.7**	**1.9**
Eastern North American Freshwater Aquatic Vegetation Group	43	33.5	0.8	82.7	1.9
NONVASCULAR & SPARSE VASCULAR ROCK VEGETATION CLASS	**65**	**46.3**	**0.7**	**114.4**	**1.8**
Eastern North American Lake & River Bluff Group	30	32.2	1.1	79.7	2.7
Great Lakes Cliff & Shore Group	35	14.1	0.4	34.8	1.0
NVCS Subtotal	**4,732**	**17,600.9**	**3.7**	**43,492.9**	**9.2**
DEVELOPED VEGETATION CULTURAL CLASS					
Developed Area	46	54.2	1.2	133.9	2.9
NVCS Cultural Subtotal	**46**	**54.2**	**1.2**	**133.9**	**2.9**
NON-NVCS UNITS					
Open Water	27	11,269.3	417.4	27,847.0	1,031.4
Barren Land	57	47.5	0.8	117.3	2.1
Non-NVCS Subtotal	**84**	**11,316.8**	**134.7**	**27,964.3**	**332.9**
Grand Total	**4,862**	**28,971.9**	**6.0**	**71,591.1**	**14.7**

Brief Analysis and Discussion

Collectively, the APIS spatial database layer is composed of 4,862 polygons covering 28,971.9 ha, with an average polygon size of 6.0 ha. Map classes representing natural/semi-natural types in the NVCS apply to 4,732 polygons (97.3% of all polygons, having an average polygon size of 3.7 ha) and cover 17,601.0 ha (60.8% of the entire area). (The area is substantially lower than the polygon frequency largely because of the jurisdictional waters mapped of Lake Superior surrounding each island and the mainland.) The Forest & Woodland Class in the NVCS applies to the majority of polygons and area covered by types in the NVCS, with 4,206 polygons (88.9% of natural/semi-natural polygons, having an average polygon size of 4.0 ha) covering 17,006.0 ha (96.6% of area covered by the NVCS types). The Forest & Woodland Class is largely dominated by the Northern Hardwood - Hemlock - White Pine Forest Group (G163), both in polygon frequency (3,257 polygons or 77.5%) and in area (15,661.9 ha or 92.1%). This dominance by G163 is largely because of the Maple - Yellow Birch Northern Hardwoods Forest (FMB) map class having 1,344 polygons (averaging 8.3 ha in polygon size) and covering 11,201.7 ha. This quick analysis indicates that the APIS is largely covered by upland hardwood forests.

The non-vegetated landscape comprises about a third of the map-layer area (consisting of only 84 polygons or 1.7% of all polygons) yet covers 11,316.7 ha (39.1% of the entire area). The average polygon size for map classes representing non-vegetated features (those not in the NVCS) is considerably larger than that of map classes representing NVCS types (map classes representing non-vegetated features have an average polygon size of 134.7 ha). This is largely due to the surface water jurisdiction into Lake Superior surrounding each island and the mainland unit. Of the map classes representing non-vegetated features, the Open Water Lake (NWL) map class (although only 23 polygons, with an average polygon size of 489.9 ha) dominates in area (11,267.5 ha or 99.6% of the non-vegetated area). The non-vegetated map class having twice as many polygons as NWL is Sand & Cobble Beach (NSB); however, this class covers a nominal piece of the landscape (47.5 ha or 0.4% of the non-vegetated area), with an average polygon size of 0.8 ha.

The cultural landscape classified in the NVCS comprises a nominal portion of the map layer, consisting of a mere 46 polygons (1.0% of all polygons, with an average polygon size of 1.2 ha) and covering 54.2 ha (0.2% of the entire area). The sole map class capturing the cultural landscape is Developed Area (NDV), which represents cultural vegetation of campgrounds, homesteads, roads, etc.

Considerable 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., the APIS lands excluding the environs, individual islands or the mainland unit) by clipping the map layer to its desired location and running a new summary. Also, more complex summary reports can be derived, either from the map layer alone (e.g., employing the physiognomic modifiers of coverage, pattern, and height) 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 18 presents the map layer produced for the APIS 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 18 is generalized, collapsing map classes at the group level within the NVCS.

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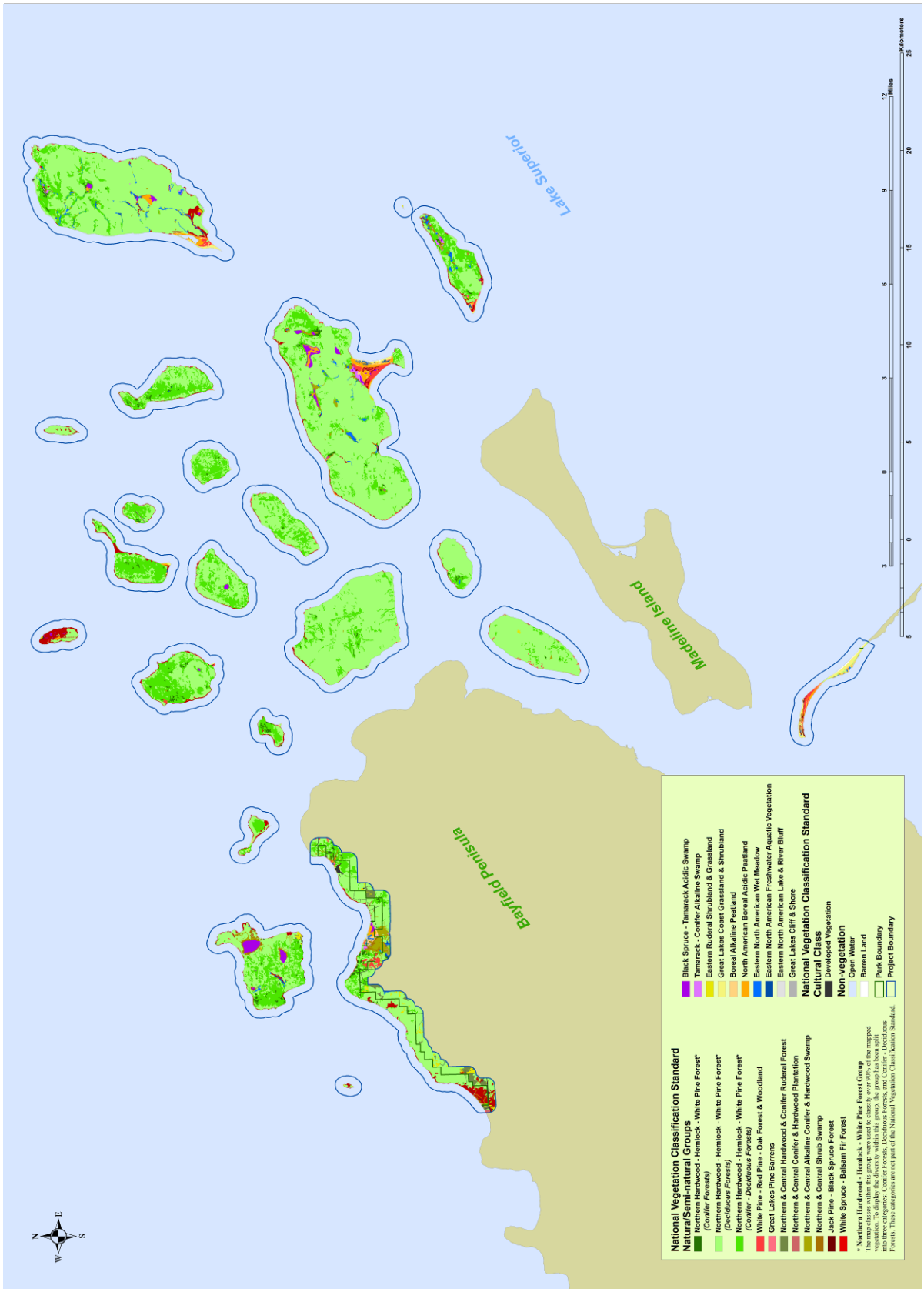


Figure 18. Vegetation of Apostle Islands National Lakeshore and environs, presented at the natural/semi-natural group and the cultural class levels of the National Vegetation Classification Standard (Version 2).

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 at Apostle Islands National Lakeshore (APIS). We included all primary map classes representing natural/semi-natural floristic vegetation types[7] 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.) All locations within the APIS boundary having public access were included in the sampling design. The number of samples needed for each map class (theme) was determined by using Program recommendations for a medium-sized park (TNC et al. 1994), as suggested in the following scenarios:

Scenario A: The class is abundant. It covers more than 50 ha of the total area and consists of at least 30 polygons. The recommended sample size is 30.

Scenario B: The class is relatively abundant. It covers more than 50 ha of the total area but consists of fewer than 30 polygons. The recommended sample size is 20. The rationale for reducing the sample size for this type of class is that sample sites are more difficult to find because of the lower frequency of the class.

Scenario C: The class is relatively rare. It covers less than 50 ha of the total area but consists of more than 30 polygons. The recommended sample size is 20. The rationale for reducing the sample size is that the class occupies a small area. At the same time, however, the class consists of a considerable number of distinct polygons that are possibly widely distributed. The number of samples therefore remains relatively high because of the high frequency of the class.

[7] 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).

Scenario D: The class is rare. It has more than five but fewer than 30 polygons and covers less than 50 ha of the area. The recommended number of samples is five. The rationale for reducing the sample size is that the class consists of small polygons, and the frequency of the polygons is low. Specifying more than five sample sites will therefore probably result in multiple sample sites within the same (small) polygon. Collecting five sample sites will allow an accuracy estimate to be computed, although it will not be very precise.

Scenario E: The class is very rare. It has fewer than five polygons and occupies less than 50 ha of the total area. In this case, it is recommended that the existence of the class be confirmed by a visit to each sample site. The rationale for the recommendation is that with fewer than five sample sites (assuming one site per polygon), no estimate of level of confidence can be established for the sample (the existence of the class can only be confirmed through field checking).

The recommendations above take into account both the statistical and operational aspects of sampling. 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. A 10-m buffer was applied interior to the polygon boundaries to promote global positioning system (GPS) navigation into the correct polygon. Random AA points (coordinates) were generated for each map class by using Hawth's Tools for ArcGIS (Beyer 2004). The AA points were then assigned a random number used to identify each AA site location.

We equipped the field crews with several tools to maximize their ability to accurately locate each AA site. We plotted 1:12,000-scale, hard-copy maps showing locations of the AA sites, the unlabelled polygon boundaries of the vegetation map, and the project boundary with the color-infrared aerial photomosaic displayed as a background. The AA-site coordinates were uploaded into GPS receivers, projected in Universal Transverse Mercator (UTM), Zone 15, using the North American Datum of 1983 (NAD83).

Field Data Collection

Once an AA site was reached by using the tools described above, an area equal to the size of a minimum mapping unit (MMU) within the map polygon was to be evaluated. Using the field key, the field crews determined the appropriate vegetation type. The field crews also recorded the GPS coordinate location in the field, dominant species, environmental data, and pertinent comments. For a sample data sheet, refer to Appendix F: Accuracy Assessment Form. If the area was not homogeneous (containing more than one vegetation type), the other appropriate vegetation types were also listed on the data sheet.

Data Analyses

Field data for 687 AA sites were collected and entered into the National Park Service (NPS) PLOTS Database Version 2 (NatureServe 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-site coordinates, a missing or misapplied field-site call, or a field-site assessment of an area smaller than the 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. The following explains our process further:

(1) Spatial error–A spatial error might occur in one of two of the following ways: (1) the GPS acquired inaccurate field coordinates or (2) a geospatial error existed within the vegetation map layer (called a “map-layer shift”). Either of these spatial errors could displace the newly acquired field coordinate inside an adjacent polygon on the map layer. From selecting sites more than 10 m from polygon edges, we were able to minimize spatial errors in GPS coordinates, yet occasionally GPS accuracy could fall outside this parameter. Some areas of APIS were difficult to orthoreference because of a lack of obvious ground controls, thus causing slight shifts in the map layer. These two phenomenon—GPS error and map-layer shift—caused many of the AA field coordinates to fall outside the intended map polygon. An AA site determined to have been spatially displaced was adjusted accordingly for the analysis.

(2) Questionable field call–A field-assessment call might be questioned during the analysis, especially when the perspective from the ground was limited by poor vantage points, such as heavy cover of vegetation or wet soils preventing the field worker from walking around the MMU. If the MMU area was diverse, with more than one map class represented, it was possible to miss or not recognize other vegetation types present. We reviewed these situations by checking the aerial photographs for diversity at the site and by reviewing the field data sheets to

check for possible problems. We also reviewed the data for the possibility of an incorrect vegetation class or another vegetation class not having been recorded. Thus, we were able to update our analysis tables to reflect any additions or changes to the field call in preparation for the second comparative analysis. (We also updated the PLOTS Database.)

(3) Inclusion–The area assessed in the field during the AA might be less than the MMU for mapping (termed an inclusion). We discovered several instances where, after reviewing the aerial photographs, we could tell the site was an inclusion to the surrounding map class. Certain vegetation features can be quite apparent from each other on the aerial photographs (e.g., open woodland versus dense forest), allowing easy assessment of site inclusions in the lab. Another type of inclusion occurred when an area in the field was a valid MMU, but the assessed area overlapped into an adjacent polygon. Particularly with smaller polygons adjacent to similar vegetation types, it was sometimes difficult to determine if the area assessed actually fell within the intended polygon.

Final Comparison: Of the 687 AA sites originally collected, we dropped 14 sites because of problems with the data (e.g., missing UTM coordinates, unrectifiable spatial errors, or incomplete data). We used the remaining 673 AA sites for the final comparative analysis of the vegetation map layer (Figure 19).

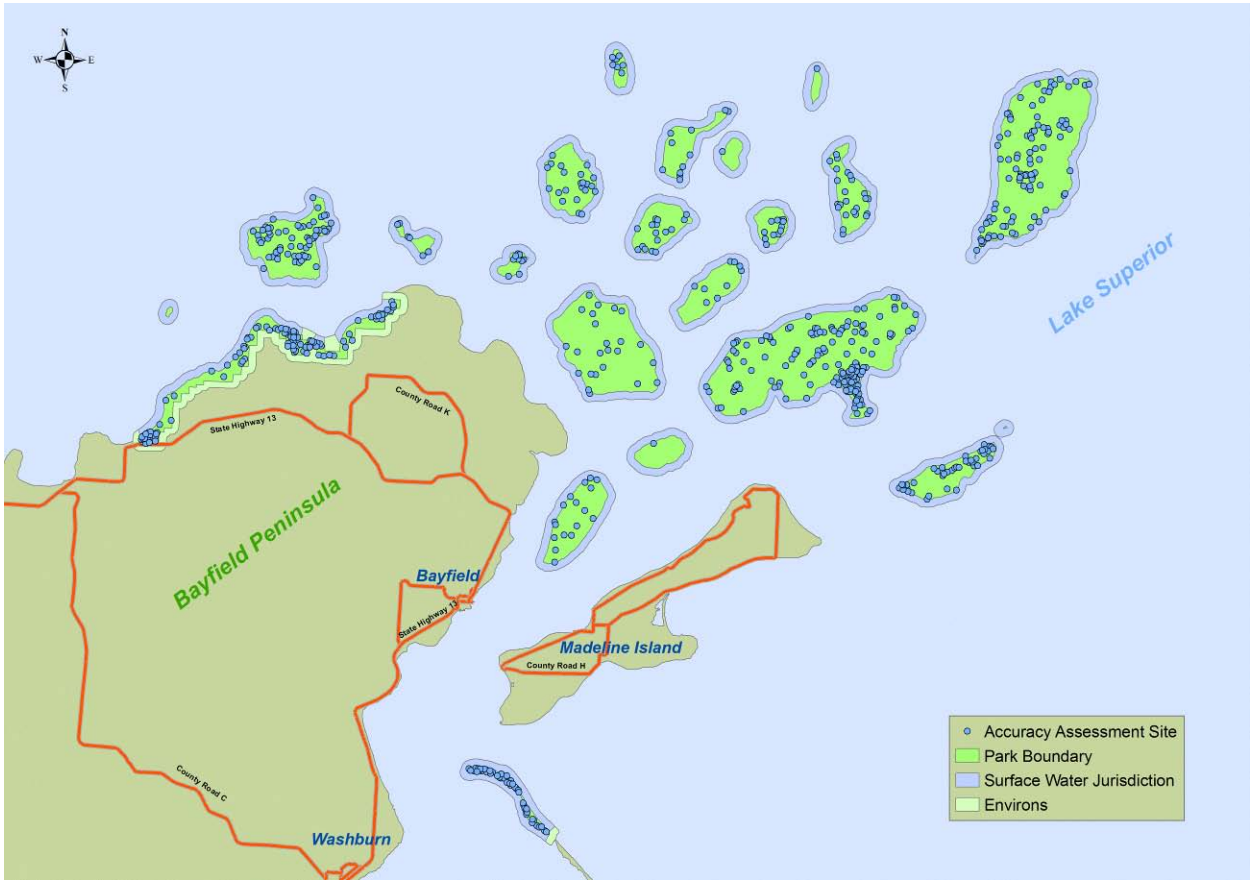


Figure 19. Locations of accuracy assessment sites used to validate the vegetation map layer for the Apostle Islands National Lakeshore.

Individual Map-class Analysis: For individual map-class accuracies falling below standards of the NPS Vegetation Inventory Program (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 to gain higher accuracy or to leave the map classes as they were, even if it resulted in lower accuracy. These determinations were made with input from NPS staff (APIS and Great Lakes Network Inventory & Monitoring).

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 APIS vegetation mapping project geodatabase. The field data are also included in the PLOTS Database for the project.

Results

Overall accuracy is 87.7% for primary map classes representing natural/semi-natural vegetation 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 87.2%. 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) present in the mapping. The width of each confidence interval is affected by the sample size used to derive the point estimate.

Our overall AA exceeded the NPS VIP accuracy requirement of 80%. Most individual map classes also met the 80% requirement, with many at 100% accuracy.

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Appendix A: Plot Sampling Form

NATIONAL PARK VEGETATION MAPPING PROGRAM: PLOT SURVEY FORM

IDENTIFIERS/LOCATORS

Plot Code_____ Polygon Code_____

Provisional CommunityName_____

State____ Park Name_____ Park Site Name_____

Quad Name_____ Quad Code_____

GPS file name_____ Field UTM X__ __ __ __ __ __ m E Field UTM Y__ __ __ __ __ __ __ m N

Waypoint_____ Zone_____ Datum_____ Error +/-_____ m Elevation_____

please do not complete the following information when in the field

Corrected UTM X___ ___ ___ ___ ___ ___ m E Corrected UTM Y___ ___ ___ ___ ___ ___ ___ m N

Survey Date_____ Surveyors_____

Directions to Plot:

Plot length____ (m) Plot width____ (m) Camera_____ Number of images____ Time of Photos_____

Plot representativeness:

Is the surrounding ~1 hectare area all the same? ___yes ___no

Please draw a map of plot here with plot shape,
where plot photos were taken, potential community
boundary breaks, and important landmarks.

ENVIRONMENTAL DESCRIPTION

Slope_____Aspect_____

Topographic Position

Landform

Surficial Geology

Cowardian System
___Upland
___Riverine
___Palustrine
___Lacustrine

Non-Tidal
___Permanently Flooded
___Semipermanently Flooded
___Seasonally/Temporarily Flooded
___Saturated
___Seasonally Flooded/Saturated
___Intermittently Flooded

Environmental Comments:	Soil Taxon/Description
	Unvegetated Surface: *(percent – total should equal 100%)* ___Bedrock ___Litter, duff ___Wood (> 1 cm) ___Large rocks (cobbles, boulders > 10 cm) ___Small rocks (gravel, 0.2-10 cm) ___Sand (0.1-2 mm) ___Bare soil ___Other:_____
Soil Texture ___sand ___loamy sand ___sandy loam ___loam ___silt loam ___silt ___clay loam ___silty clay ___silty clay loam ___clay ___peat ___muck	Soil Drainage ___Rapidly drained ___Well drained ___Moderately well drained ___Somewhat poorly drained ___Poorly drained ___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>		___Forest	P	5%		
___Evergreen	___Broad-leaved	___Woodland	01	10%	01	<0.5 m
___Cold-deciduous	___Needle-leaved	___Shrubland	02	20%	02	0.5-1m
___Drought-deciduous	___Mixed Needle-leaved - Broad-leaved	___Dwarf Shrubland	03	30%	03	1-2 m
___Mixed evergreen - cold-deciduous	___Microphyllous	___Herbaceous	04	40%	04	2-5 m
	___Graminoid	___Nonvascular	05	50%	05	5-10 m
___Mixed evergreen - drought-deciduous	___Forb	___Sparsely Vegetated	06	60%	06	10-15 m
<u>Herbs</u>	___Pteridophyte		07	70%	07	15-20 m
___Annual			08	80%	08	20-35 m
___Perennial			09	90%	09	35-50 m
			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:

Plot Code ____

Species/percent cover: Starting with the uppermost stratum, list all species with cover class for each species in the stratum. For forests and woodlands, on a separate line below each tree species, list the DBH of all trees above 10 cm diameter. Separate measurements with a comma. Put an asterisk next to any species that are known diagnostics for a particular community in the classification.

Stratum	Species Name	Cover Class	Stratum	Species Name	Cover Class

Cover Scale for Species: T=<1%; P=1-5%; 01=5-15%; 02=15-25%; 03=25-35%; 04=35-45%; 05=45-55%; 06=55-65%; 07=65-75%; 08=75-85%; 09=85-95%; 10=>95%

Appendix B: Descriptions of Vegetation Types

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U.S. NATIONAL VEGETATION CLASSIFICATION

APOSTLE ISLANDS NATIONAL LAKESHORE

3 November 2009

by

NatureServe

1101 Wilson Blvd., 15th floor
Arlington, VA 22209

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

This subset of the International Ecological Classification Standard covers the vegetation associations attributed to Apostle Islands National Lakeshore. 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>.



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[1] 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, Querry 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-Departmento De Recursos Naturales Y Ambientales, Puerto Rico; Virgin Islands Conservation Data Center, St. Thomas, Virgin Islands.

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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

Maple - Yellow Birch Northern Hardwoods Forest

***Acer saccharum - Betula alleghaniensis - (Tilia americana)* Forest**
Sugar Maple - Yellow Birch - (American Basswood) Forest
Identifier: CEGL002457

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)	Maple - Yellow Birch Northern Hardwoods Forest
Ecological System(s):	Laurentian-Acadian Northern Hardwoods Forest (CES201.564)

ELEMENT CONCEPT

Global Summary: This northern hardwoods community type occurs in the western and central Great Lakes area of the United States and Canada. Stands are found on moderate to deep (60->150 cm) sandy loam, clay loam, or loamy sand soils. The soils are typically slightly acidic to circumneutral, dry-mesic to wet-mesic and moderately nutrient rich. Most stands develop on flat to moderate slopes over glacial till. The community is dominated by deciduous trees with scattered conifers in some stands. *Acer saccharum* (sugar maple) is a dominant throughout the range of this community. It may form nearly pure stands. Other common canopy trees include *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Fraxinus americana* (white ash), and *Tilia americana* (American basswood). Conifers such as *Abies balsamea* (balsam fir), *Picea glauca* (white spruce), *Pinus strobus* (eastern white pine), *Thuja occidentalis* (northern white-cedar), and *Tsuga canadensis* (eastern hemlock) can be found in some stands. The shrub layer is typically sparse; however, it can be moderately developed where the tree canopy is not fully closed. Typical shrubs include *Acer spicatum* (mountain maple), *Corylus cornuta* (beaked hazelnut), *Lonicera canadensis* (American fly honeysuckle), and *Taxus canadensis* (Canada yew). The herbaceous stratum includes *Clintonia borealis* (bluebead), *Dryopteris carthusiana* (spinulose woodfern), *Lycopodium* (clubmoss) spp., *Maianthemum canadense* (Canada mayflower), *Maianthemum racemosum* (feathery false lily of the valley), *Osmorhiza claytonii* (Clayton's sweetroot), *Polygonatum pubescens* (hairy Solomon's seal), *Streptopus lanceolatus* var. *longipes* (twistedstalk), and *Viola* (violet) spp. Diagnostic features include the deciduous hardwood dominance, the lack of *Fagus grandifolia* (American beech), and the presence of a sub-boreal ground layer.

ENVIRONMENTAL DESCRIPTION

Apostle Islands National Lakeshore Environment: This northern hardwoods forest is one of the most common communities in the park and was sampled at 23 locations: Basswood Island (1 plot), Bear Island (1) Little Sand Bay (1), Michigan Island (3), Oak Island (6), Outer Island (4), Sand Island (2), and Stockton Island (4). Sites are generally on gentle mid- and upper slope moraines of any aspect. Elevations range from 205 to 300 m (672-992 feet). Soils range from rapidly drained sand to moderately well-drained loam, loamy sand, silt loam, sandy loam and sand to somewhat poorly drained silt. The unvegetated surface is dominated by leaf litter (50-99% cover) with some wood (0-25%); one site had 50% cover of bare soil. Evidence of disturbance includes trails, wind damage, past logging and fire, and the presence of exotic plants.
Global Environment: This community is found on moderate to deep (60-150 cm) sandy loam, clay loam, or loamy sand soils (Coffman and Willis 1977, Pregitzer and Barnes 1984). The soils are typically slightly acidic to circumneutral, mesic to wet-mesic and nutrient rich (Kotar and Burger 1989). Most stands develop on flat to moderate slopes over glacial till.

VEGETATION DESCRIPTION

Apostle Islands National Lakeshore Vegetation: The moderate to very dense (50-90% cover) tree canopy, 15-50 m tall, is variously dominated by a mixture of *Acer rubrum* (red maple), *Acer saccharum* (sugar maple), *Betula alleghaniensis* (yellow birch), *Betula papyrifera* (paper birch), *Populus grandidentata* (bigtooth aspen), *Populus tremuloides* (quaking aspen), and *Quercus rubra* (northern red oak). The sparse to moderately dense (20-70%) subcanopy (5-20 m) is dominated by *Acer saccharum* (sugar maple) and may include *Abies balsamea* (balsam fir), *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Ostrya virginiana* (hophornbeam), *Thuja occidentalis* (northern white-cedar), and *Tsuga canadensis* (eastern hemlock). The very sparse to moderate (5-60%) tall-shrub layer (2-5 m) made up of species of the upper layers as well as *Acer spicatum* (mountain maple) and *Corylus cornuta* (beaked hazelnut). The very sparse to moderately dense (5-70%) short-shrub layer (0.5-2 m) is dominated by *Taxus canadensis* (Canada yew); additional short shrubs include *Amelanchier* (serviceberry) sp., *Corylus cornuta* (beaked hazelnut), *Diervilla lonicera* (northern bush honeysuckle), and *Lonicera canadensis* (American fly honeysuckle). The variable herbaceous layer (10-80%) may be is often dominated by tree seedlings (particularly *Acer saccharum* (sugar maple) but many others as well); additional common and/or

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dominant species include *Aralia nudicaulis* (wild sarsaparilla), *Carex* (sedge) spp., *Clintonia borealis* (bluebead), *Eurybia macrophylla* (bigleaf aster), *Maianthemum canadense* (Canada mayflower), *Streptopus lanceolatus* var. *roseus* (twistedstalk), and *Trientalis borealis* (starflower). Many ferns and fern allies are found in this community, including *Athyrium filix-femina* (common ladyfern), *Dryopteris intermedia* (intermediate woodfern), *Huperzia lucidula* (shining clubmoss), *Lycopodium annotinum* (stiff clubmoss), *Lycopodium dendroideum* (tree groundpine), *Onoclea sensibilis* (sensitive fern), *Osmunda cinnamomea* (cinnamon fern), *Osmunda claytoniana* (interrupted fern), and *Phegopteris connectilis* (long beechfern). Nonvascular species may cover 5-10% of the ground surface. In addition, state-imperiled (S2) *Goodyera oblongifolia* (western rattlesnake plantain) was recorded in at least one of the sampled plots.

Global Vegetation: This forest community is dominated by deciduous trees with scattered conifers in some stands. *Acer saccharum* (sugar maple) is a dominant throughout the range of this community. It may form nearly pure stands (Flaccus and Ohmann 1964, Hansen et al. 1973). Other common canopy trees include *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Fraxinus americana* (white ash), and *Tilia americana* (American basswood). Conifers, such as *Abies balsamea* (balsam fir), *Picea glauca* (white spruce), *Pinus strobus* (eastern white pine), *Thuja occidentalis* (northern white-cedar), and *Tsuga canadensis* (eastern hemlock), can be found in some stands. The shrub layer is sparse; however, it can be moderately developed where the tree canopy is not fully closed. Typical shrubs include *Acer spicatum* (mountain maple), *Corylus cornuta* (beaked hazelnut), *Lonicera canadensis* (American fly honeysuckle), and *Taxus canadensis* (Canada yew). The herbaceous stratum includes *Clintonia borealis* (bluebead), *Lycopodium* (clubmoss) spp., *Maianthemum canadense* (Canada mayflower), *Osmorhiza claytonii* (Clayton's sweetroot), *Streptopus lanceolatus* (twistedstalk), and *Viola* (violet) spp. (Chambers et al. 1997).

MOST ABUNDANT SPECIES

Apostle Islands National Lakeshore

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Acer saccharum* (sugar maple)
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Betula papyrifera* (paper birch), *Populus grandidentata* (bigtooth aspen), *Quercus rubra* (northern red oak)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Acer saccharum* (sugar maple), *Acer spicatum* (mountain maple)
Short shrub/sapling	Needle-leaved shrub	*Taxus canadensis* (Canada yew)
Herb (field)	Fern or fern ally	*Dryopteris intermedia* (intermediate woodfern)

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Acer rubrum* (red maple), *Acer saccharum* (sugar maple), *Acer spicatum* (mountain maple), *Aralia nudicaulis* (wild sarsaparilla), *Betula alleghaniensis* (yellow birch), *Betula papyrifera* (paper birch), *Clintonia borealis* (bluebead), *Dryopteris intermedia* (intermediate woodfern), *Eurybia macrophylla* (bigleaf aster), *Huperzia lucidula* (shining clubmoss), *Populus grandidentata* (bigtooth aspen), *Quercus rubra* (northern red oak), *Taxus canadensis* (Canada yew)

OTHER NOTEWORTHY SPECIES

Apostle Islands National Lakeshore: Vulnerable: *Goodyera oblongifolia* (western rattlesnake plantain, state-imperiled, G5?); **Exotic/Invasive**: *Sorbus aucuparia* (european mountain-ash, exotic)

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G4 (22-Jun-1998). There are probably over 100 occurrences rangewide. Ninety have been documented: 77 in Minnesota (where the community is ranked S2), 10 in Wisconsin (S4), and 3 in Michigan (S4). Although no other occurrences have been documented, the community is also reported from Ontario. The 90 occurrences total 13,401 acres (5360 ha). The type has been extensively cleared for development or harvested for timber in the past (between 50 and 90% of its former extent), but degree of conversion versus second-growth status is not well-understood. Few old-growth stands remained by the late 1980s.

CLASSIFICATION

Status: Standard

Classification Confidence: 2 - Moderate

Global Comments: This community has a sub-boreal herbaceous layer. This may be a useful feature to differentiate this community from the similar *Acer saccharum - Fraxinus americana - Tilia americana / Acer spicatum / Caulophyllum thalictroides* Forest (CEGL005008). Some stands can have a scattered supercanopy of *Pinus strobus* (eastern white pine) (less than 25% cover), and although floristically such stands are very similar to this type, there may be some value in recognizing a separate type, *Acer saccharum - Pinus strobus / Acer pensylvanicum* Forest (CEGL005005). Further review of this issue is needed.

Global Similar Associations:

- *Acer saccharum - Fagus grandifolia - Betula* spp. / *Maianthemum canadense* Forest (CEGL005004)
- *Acer saccharum - Fraxinus americana - Tilia americana / Acer spicatum / Caulophyllum thalictroides* Forest (CEGL005008)--This community lacks the sub-boreal herbaceous layer.
- *Acer saccharum - Pinus strobus / Acer pensylvanicum* Forest (CEGL005005)
- *Acer saccharum - Tilia americana / Ostrya virginiana / Lonicera canadensis* Forest (CEGL002458)
- *Betula alleghaniensis - (Acer saccharum, Picea glauca)* Forest [Provisional] (CEGL005245)

Global Related Concepts:

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- *Acer / Hydrophyllum* Habitat Type (Kotar and Burger 1989) =
- *Acer saccharum - Viola pennsylvanica - Osmorhiza claytonii* Association (Coffman and Willis 1977) =
- Mesic Northern Forest - Sugar Maple-Yellow Birch-(Balsam Fir) (Chapman et al. 1989) B
- Site Unit 11 (Pregitzer and Barnes 1984) F
- Site Unit 2 (Pregitzer and Barnes 1984) F
- Site Unit 4 (Pregitzer and Barnes 1984) F
- Site Unit 5 (Pregitzer and Barnes 1984) F
- Sugar Maple-Yellow Birch-Spinulose Wood Fern (V10) (Chambers et al. 1997) =
- Yellow Birch - Sugar Maple (Hansen et al. 1973) =

ELEMENT DISTRIBUTION

Apostle Islands National Lakeshore Range: This northern hardwoods forest occurs on Basswood, Bear, Michigan, Oak, Outer, Sand, and Stockton islands, and at Little Sand Bay.
Global Range: This northern hardwoods community occurs in the western and central Great Lakes area of the United States and Canada, ranging from Minnesota and Ontario east to Michigan. Range extent is about 300,000 square km.
Nations: CA, US
States/Provinces: MI, MN:S2, ON, QC, WI:S3
TNC Ecoregions: 47:C, 48:C, 64:C
USFS Ecoregions (1994/95): 212Hb:CC?, 212Hi:CCC, 212Hj:CCP, 212Hs:CCC, 212Hv:CCP, 212Ia:CCC, 212Ib:CCC, 212Ja:CCC, 212Jb:CCC, 212Jc:CCC, 212Je:CCC, 212Jf:CCP, 212Jj:CCC, 212Jl:CCC, 212Jm:CCC, 212Jn:CCP, 212Jo:CCP, 212Jr:CCC, 212Js:CCC, 212Kb:CCC, 212La:CC?, 212Lb:CCC, 212Mb:C??, 212Na:CCC, 212Nb:CCC, 212Nc:CCC, 212Nd:CCC
Federal Lands: NPS (Apostle Islands, Isle Royale, Pictured Rocks, Saint Croix); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Hiawatha?, Huron-Manistee, Huron?, Manistee, Nicolet, Ottawa, Superior?)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (23 plots): APIS.001, APIS.011, APIS.021, APIS.023, APIS.026, APIS.027, APIS.028, APIS.029, APIS.031, APIS.101, APIS.124, APIS.126, APIS.132, APIS.135, APIS.305, APIS.315, APIS.320, APIS.321, APIS.333, APIS.334, APIS.335, APIS.401, APIS.502.
Apostle Islands National Lakeshore Map Code: FMB
Local Description Authors: M.J. Russo
Global Description Authors: J. Drake
References: Chambers et al. 1997, Chapman et al. 1989, Coffman and Willis 1977, Farrand and Bell 1982, Flaccus and Ohmann 1964, Frelich 1995, Hansen et al. 1973, Kotar and Burger 1989, MNNHP 1993, Midwestern Ecology Working Group n.d., Pregitzer and Barnes 1984, WNHIP unpubl. data

Northern Maple - Basswood Forest

***Acer saccharum - Tilia americana / Ostrya virginiana / Lonicera canadensis* Forest**
Sugar Maple - American Basswood / Hophornbeam / Fly Honeysuckle Forest
Identifier: CEGL002458

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)	Northern Maple - Basswood Forest
Ecological System(s):	Laurentian-Acadian Northern Hardwoods Forest (CES201.564)

ELEMENT CONCEPT

Global Summary: This maple-basswood forest community type is found in northern Great Lakes region of the United States and Canada. Stands occur on deep, well-drained soils formed from glacial deposits, usually till. Soils are nutrient-rich loam, silt loam, or sandy loam. Slopes are generally gentle to moderate, but can sometimes be steep. The canopy contains a closed, deciduous tree layer that casts dense shade in summer and limits the growth of understory species. This results in a sparse shrub layer 1-2 m tall and the presence of many spring ephemerals in the herbaceous layer. *Acer saccharum* (sugar maple) and *Tilia americana* (American basswood) are the most abundant trees, and together make up virtually the entire canopy in many stands. Other trees that may be found include *Fraxinus pennsylvanica* (green ash), *Ostrya virginiana* (hophornbeam), *Quercus rubra* (northern red oak), *Ulmus americana* (American elm), and, in more eastern stands, *Fagus grandifolia* (American beech). Typical shrubs are *Acer spicatum* (mountain maple), *Corylus americana* (American hazelnut), *Dirca palustris* (eastern leatherwood), *Hamamelis virginiana* (American witch-hazel), *Lonicera canadensis* (American fly honeysuckle), and *Viburnum acerifolium* (mapleleaf viburnum). The herbaceous stratum contains species such as *Adiantum pedatum* (northern maidenhair), *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Carex pensylvanica* (Pennsylvania sedge), *Desmodium cuspidatum* var. *cuspidatum* (largebract ticktrefoil), *Epipactis helleborine* (broadleaf helleborine), *Galium triflorum* (fragrant bedstraw), *Hepatica nobilis* (hepatica), *Laportea canadensis* (Canadian

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woodnettle), *Maianthemum canadense* (Canada mayflower), *Oryzopsis asperifolia* (roughleaf ricegrass), *Trillium grandiflorum* (snow trillium), and *Uvularia grandiflora* (largeflower bellwort).

ENVIRONMENTAL DESCRIPTION

Apostle Islands National Lakeshore Environment: This maple-basswood forest was sampled twice at the North Point Overlook on Oak Island. One site is flat, the other a gentle northwest-facing step-in-slope. Elevations are 260 and 276 m (848-905 feet), respectively. Soils are moderately well-drained sandy loams. The unvegetated surface is dominated by leaf litter (94-95% cover), which can be quite thick, with some wood (5-6%). Evidence of disturbance includes wind damage (tip-up mounds and downed rotting wood) and trails.

Global Environment: This community is usually found on gentle to moderate slopes but can sometimes be found on steep slopes. Stands occur on deep, well-drained soils formed from glacial deposits, usually till. Soils are nutrient-rich loam, silt loam, or sandy loam. The water table is rarely within the tree-rooting zone (MNNHP 1993).

VEGETATION DESCRIPTION

Apostle Islands National Lakeshore Vegetation: The moderately dense (70% cover) tree canopy, 20-35 m tall, is dominated by *Acer saccharum* (sugar maple) and *Tilia americana* (American basswood), the sparse (20-30%) subcanopy (15-20 m) by *Ostrya virginiana* (hophornbeam). The moderate (50%) tall-shrub layer (2-5 m) includes canopy species as well as *Corylus cornuta* (beaked hazelnut). The sparse (20-40%) short-shrub layer (0.5-2 m) includes *Corylus cornuta* (beaked hazelnut) and *Rubus parviflorus* (thimbleberry). The moderate herbaceous layer (50-60%) includes tree seedlings (particularly *Acer saccharum* (sugar maple)) along with *Carex deweyana* (Dewey sedge), *Eurybia macrophylla* (bigleaf aster), *Lycopodium obscurum* (rare clubmoss), *Maianthemum canadense* (Canada mayflower), *Polygonatum pubescens* (hairy Solomon's seal), *Streptopus lanceolatus* var. *roseus* (twistedstalk), and *Trientalis borealis* (starflower). Nonvascular species (mosses and lichens) cover only 5% of the ground surface.

Global Vegetation: The canopy contains a closed, deciduous tree layer that casts dense shade in summer and limits the growth of understory species. This results in a sparse shrub layer 1-2 m tall and the presence of many spring ephemerals in the herbaceous layer. *Acer saccharum* (sugar maple) and *Tilia americana* (American basswood) are the most abundant trees and together make up virtually the entire canopy in many stands. Other trees that may be found include *Fraxinus pennsylvanica* (green ash), *Ostrya virginiana* (hophornbeam), *Quercus rubra* (northern red oak), *Ulmus americana* (American elm), and, in more eastern stands, *Fagus grandifolia* (American beech). Typical shrubs are *Acer spicatum* (mountain maple), *Corylus americana* (American hazelnut), *Dirca palustris* (eastern leatherwood), *Hamamelis virginiana* (American witch-hazel), *Lonicera canadensis* (American fly honeysuckle), and *Viburnum acerifolium* (mapleleaf viburnum). The herbaceous stratum contains species such as *Adiantum pedatum* (northern maidenhair), *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Carex pensylvanica* (Pennsylvania sedge), *Desmodium cuspidatum* var. *cuspidatum* (largebract ticktrefoil), *Epipactis helleborine* (broadleaf helleborine), *Galium triflorum* (fragrant bedstraw), *Hepatica nobilis* var. *acuta* (sharplobe hepatica), *Laportea canadensis* (Canadian woodnettle), *Maianthemum canadense* (Canada mayflower), *Oryzopsis asperifolia* (roughleaf ricegrass), *Trillium grandiflorum* (snow trillium), and *Uvularia grandiflora* (largeflower bellwort) (Buell and Bormann 1955, Curtis 1959, MNNHP 1993, Chambers et al. 1997).

MOST ABUNDANT SPECIES

Apostle Islands National Lakeshore

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer saccharum* (sugar maple), *Tilia americana* (American basswood)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Acer saccharum* (sugar maple), *Ostrya virginiana* (hophornbeam)
Short shrub/sapling	Broad-leaved deciduous shrub	*Rubus parviflorus* (thimbleberry)
Short shrub/sapling	Broad-leaved evergreen shrub	*Corylus cornuta* (beaked hazelnut)
Herb (field)	Forb	*Eurybia macrophylla* (bigleaf aster), *Streptopus lanceolatus* var. *roseus* (twistedstalk)
Herb (field)	Fern or fern ally	*Lycopodium obscurum* (rare clubmoss)

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Acer saccharum* (sugar maple), *Corylus cornuta* (beaked hazelnut), *Eurybia macrophylla* (bigleaf aster), *Lycopodium obscurum* (rare clubmoss), *Maianthemum canadense* (Canada mayflower), *Ostrya virginiana* (hophornbeam), *Polygonatum pubescens* (hairy Solomon's seal), *Rubus parviflorus* (thimbleberry), *Streptopus lanceolatus* var. *roseus* (twistedstalk), *Tilia americana* (American basswood)

OTHER NOTEWORTHY SPECIES

Global: Vulnerable: *Panax quinquefolius* (American ginseng, collection pressure, G3G4)

CONSERVATION STATUS RANK

Global Rank & Reasons: G3? (22-Jun-1998). The total number of occurrences is unknown. Five have been documented in Wisconsin, where the community is ranked S3, and 22 in Minnesota (S3). It is found in 7 ecoregional subsections.

CLASSIFICATION

Status: Standard

Classification Confidence: 2 - Moderate

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Global Comments: Curtis' (1959) most northern maple-basswood stands belong here. This community is similar to *Acer saccharum - Tilia americana / Ostrya virginiana - Carpinus caroliniana* Forest (CEGL002062), but the canopy of this community is typically less diverse, with much less presence of some of the southern tree species found in the latter, such as *Juglans nigra* (black walnut), *Carya* (hickory) spp., and many *Quercus* (oak) spp. (Janssen 1967). This community also lacks appreciable amounts of *Betula alleghaniensis* (yellow birch) and *Tsuga canadensis* (eastern hemlock) which are found to the east and north in similar forests, such as *Acer saccharum - Betula alleghaniensis - (Tilia americana)* Forest (CEGL002457) and *Tsuga canadensis - Acer saccharum - Betula alleghaniensis* Forest (CEGL005044). In Minnesota, all stands of *Acer saccharum* (sugar maple) - northern hardwoods in the Lake Superior Highlands region are placed in CEGL002457, but it may be that the more southern stands should be placed within this type. In Ontario this type occurs in Site Region 5, but may extend into Site Region 6.

Global Similar Associations:
- *Acer saccharum - Betula alleghaniensis - (Tilia americana)* Forest (CEGL002457)
- *Acer saccharum - Fagus grandifolia - Betula* spp. / *Maianthemum canadense* Forest (CEGL005004)
- *Acer saccharum - Tilia americana / Ostrya virginiana - Carpinus caroliniana* Forest (CEGL002062)
- *Tsuga canadensis - Acer saccharum - Betula alleghaniensis* Forest (CEGL005044)

Global Related Concepts:
- *Tilio-Acerion sacchari* Alliance (Janssen 1967) =
- East Woods (Eggler 1938) F
- Hunt Hill (Eggler 1938) F
- Long Lake (Eggler 1938) F
- Sugar Maple - Basswood Stand (Buell and Bormann 1955) =
- Sugar Maple-Red Oak-Basswood-Ironwood-Leatherwood (V5) (Chambers et al. 1997) =

ELEMENT DISTRIBUTION

Apostle Islands National Lakeshore Range: This maple-basswood forest was sampled at the North Point Overlook on Oak Island.
Global Range: This maple - basswood forest community type is found in northern Great Lakes region of the United States and Canada, ranging from Minnesota and Wisconsin into Ontario.
Nations: CA, US
States/Provinces: MN:S3, ON, QC:S3?, WI:S2S3
TNC Ecoregions: 47:C, 48:C
USFS Ecoregions (1994/95): 212Ia:CCC, 212Ja:CCC, 212Jc:CCC, 212Jg:CCC, 212Mb:CPP, 212Na:CCC, 212Nb:CCP, 212Nc:CCC
Federal Lands: NPS (Apostle Islands, Saint Croix); USFS (Chippewa)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (2 plots): APIS.302, APIS.303.
Apostle Islands National Lakeshore Map Code: FMT
Local Description Authors: M.J. Russo
Global Description Authors: J. Drake, mod. D. Faber-Langendoen 06-00
References: Buell and Bormann 1955, Chambers et al. 1997, Curtis 1959, Eggler 1938, Janssen 1967, MNNHP 1993, Midwestern Ecology Working Group n.d., WNHIP unpubl. data

Yellow Birch - (White Spruce) Forest

***Betula alleghaniensis - (Acer saccharum, Picea glauca)* Forest [Provisional]**
Yellow Birch - (Sugar Maple, White Spruce) Forest
Identifier: CEGL005245

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)	Yellow Birch - (White Spruce) Forest

ELEMENT CONCEPT

Global Summary: This yellow birch forest type is provisionally reported from Isle Royale, Michigan, but its rangewide status is still unclear. It may extend to the east, until *Picea rubens* (red spruce) enters into the range. At Isle Royale National Park, this community occupies gentle to steep slopes at elevations from 190-240 m (630-780 feet). Soils are moderately well-drained to rapidly drained sandy loams. The vegetation forms a closed-canopy, deciduous forest. Canopy cover is usually about 70-80% cover (sometimes less); the most abundant trees are *Betula alleghaniensis* (yellow birch), *Picea glauca* (white spruce) and *Betula papyrifera* (paper birch). There is often a subcanopy with 5-30% cover (same species as in the canopy). Cover of tall shrubs is about 5-10% cover; the most abundant tall shrubs are saplings of *Picea glauca* (white spruce) and *Abies balsamea* (balsam fir), and *Sambucus racemosa* (red elderberry). Cover of short shrubs varies from 10-70% cover; the most abundant short shrubs are *Rubus parviflorus* (thimbleberry), *Sorbus decora* (northern mountain-ash), *Diervilla lonicera* (northern bush honeysuckle), *Lonicera canadensis* (American fly honeysuckle), and *Rubus idaeus* (American red raspberry). There is a sparse cover of dwarf-shrubs, mainly *Rubus pubescens* (dwarf

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red blackberry). Cover of herbs varies from 40-80% cover; the most abundant herbs are *Aralia nudicaulis* (wild sarsaparilla), *Cornus canadensis* (bunchberry dogwood), *Clintonia borealis* (bluebead), *Lycopodium annotinum* (stiff clubmoss), *Streptopus lanceolatus* var. *roseus* (twistedstalk), *Athyrium filix-femina* (common ladyfern), and *Oxalis montana* (mountain woodsorrel). Cover of nonvascular plants is sparse (0-10% cover); *Pleurozium schreberi* (Schreber's big red stem moss) is characteristic.

ENVIRONMENTAL DESCRIPTION

Global Environment: At Isle Royale National Park, this community occupies gentle to steep slopes at elevations from 190-240 m (630-780 feet). Soils are moderately well-drained to rapidly drained sandy loams (C. Reschke pers. comm. 1999).

VEGETATION DESCRIPTION

Global Vegetation: At Isle Royale National Park, the vegetation forms a closed-canopy deciduous forest. Canopy cover is usually about 70-80% cover (sometimes less); the most abundant trees are *Betula alleghaniensis* (yellow birch) (20-60% cover), *Picea glauca* (white spruce) (5-50% cover) and *Betula papyrifera* (paper birch) (5-25% cover). There is often a subcanopy with 5-30% cover (same species as in the canopy). Cover of tall shrubs is about 5-10% cover; the most abundant tall shrubs are saplings of *Picea glauca* (white spruce) and *Abies balsamea* (balsam fir), and *Sambucus racemosa* (red elderberry). Cover of short shrubs varies from 10-70% cover; the most abundant short shrubs are *Rubus parviflorus* (thimbleberry), *Sorbus decora* (northern mountain-ash), *Diervilla lonicera* (northern bush honeysuckle) (each with 5-25% cover), *Lonicera canadensis* (American fly honeysuckle) and *Rubus idaeus* (American red raspberry) (each with 1-5% cover). There is a sparse cover of dwarf-shrubs, mainly *Rubus pubescens* (dwarf red blackberry). Cover of herbs varies from 40-80% cover; the most abundant herbs are *Aralia nudicaulis* (wild sarsaparilla) (5-25% cover), *Cornus canadensis* (bunchberry dogwood) (5-25% cover), *Clintonia borealis* (bluebead), *Lycopodium annotinum* (stiff clubmoss), *Streptopus lanceolatus* var. *roseus* (twistedstalk), *Athyrium filix-femina* (common ladyfern), and *Oxalis montana* (mountain woodsorrel) (each with 1-5% cover). Cover of nonvascular plants is sparse (0-10% cover); *Pleurozium schreberi* (Schreber's big red stem moss) is characteristic (less than 1% cover) (C. Reschke pers. comm. 1999).

OTHER NOTEWORTHY SPECIES

Global: Other: *Streptopus lanceolatus* var. *roseus* (twistedstalk, G5T4)

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (29-Mar-1999).

CLASSIFICATION

Status: Provisional
Classification Confidence: 3 - Weak
Global Comments: Type needs rangewide review. This community is distinguished from sugar maple - yellow birch - northern hardwood forest, *Acer saccharum - Betula alleghaniensis - (Tilia americana)* Forest (CEGL002457), by the absence or very low cover of *Acer saccharum* (sugar maple) in either the canopy or as seedlings and saplings in the ground layer, but it may just be a variant of that type.
Global Similar Associations:
- *Acer saccharum - Betula alleghaniensis - (Tilia americana)* Forest (CEGL002457)
- *Thuja occidentalis - Betula alleghaniensis* Forest (CEGL002450)

Global Related Concepts:
- Mesic Northern Forest - Sugar Maple-Yellow Birch-(Balsam Fir) (Chapman et al. 1989) ?

ELEMENT DISTRIBUTION

Global Range: This type is reported from Isle Royale, Michigan; its rangewide distribution is unclear, but it may extend to the east, until *Picea rubens* (red spruce) enters into the range.
Nations: CA, US
States/Provinces: MI, ON, QC:S4, WI
TNC Ecoregions: 48:P
USFS Ecoregions (1994/95): 212Ia:CCC
Federal Lands: NPS (Apostle Islands, Isle Royale)

ELEMENT SOURCES

Apostle Islands National Lakeshore Map Code: FYB
Local Description Authors:
Global Description Authors: D. Faber-Langendoen
References: Chapman et al. 1989, Midwestern Ecology Working Group n.d., Reschke pers. comm.

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Great Lakes White Pine - Hemlock Forest

***Pinus strobus* - *Tsuga canadensis* Great Lakes Forest**
Eastern White Pine - Eastern Hemlock Great Lakes Forest
Identifier: CEGL002590

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)	Great Lakes White Pine - Hemlock Forest
Ecological System(s):	Laurentian-Acadian Pine-Hemlock-Hardwood Forest (CES201.563)

ELEMENT CONCEPT

Global Summary: This white pine - hemlock forest type is found in the Great Lakes region of the United States and Canada. Stands occur on acidic, nutrient-poor, usually moderately well-drained soils such as sandy loams. Generally, *Tsuga canadensis* (eastern hemlock) and *Pinus strobus* (eastern white pine) are codominant, but other common associates include *Fagus grandifolia* (American beech), *Acer rubrum* (red maple), *Betula lenta* (sweet birch), *Betula alleghaniensis* (yellow birch), and *Quercus rubra* (northern red oak). *Quercus rubra* (northern red oak) becomes more prevalent in the south. Typical shrubs include *Acer spicatum* (mountain maple), *Hamamelis virginiana* (American witch-hazel), and *Acer pensylvanicum* (striped maple). The herbaceous layer may be sparse and generally depauperate, including *Trientalis borealis* (starflower), *Cypripedium acaule* (moccasin flower), *Maianthemum canadense* (Canada mayflower), *Gaultheria procumbens* (eastern teaberry), *Clintonia borealis* (bluebead), and *Lycopodium* (clubmoss) spp. Diagnostic features include the dominance of both *Pinus strobus* (eastern white pine) and *Tsuga canadensis* (eastern hemlock), with a sparse, sub-boreal ground layer.

ENVIRONMENTAL DESCRIPTION

Global Environment: This community is found on acidic, nutrient-poor, usually moderately well-drained soils such as sandy loams. In the north, it may occur on ridges with a fragipan, and to the south the more prevalent habitat is higher elevations and north-facing slopes (Eyre 1980). In northern Michigan and northeastern Wisconsin, this community is commonly found on beach ridges and dunes within glacial lakebeds on poorly drained lakeplains.

VEGETATION DESCRIPTION

Global Vegetation: Generally, *Tsuga canadensis* (eastern hemlock) and *Pinus strobus* (eastern white pine) are codominant, but other common associates include *Fagus grandifolia* (American beech), *Acer rubrum* (red maple), *Betula lenta* (sweet birch), *Betula alleghaniensis* (yellow birch), and *Quercus rubra* (northern red oak). *Quercus rubra* (northern red oak) becomes more prevalent in the south. Typical shrubs include *Acer spicatum* (mountain maple), *Hamamelis virginiana* (American witch-hazel), and *Acer pensylvanicum* (striped maple). The herbaceous layer may be sparse and generally depauperate, including *Trientalis borealis* (starflower), *Cypripedium acaule* (moccasin flower), *Maianthemum canadense* (Canada mayflower), *Gaultheria procumbens* (eastern teaberry), *Clintonia borealis* (bluebead), and *Lycopodium* (clubmoss) spp. (Eyre 1980).

CONSERVATION STATUS RANK

Global Rank & Reasons: G3 (24-Oct-2002). This white pine - hemlock forest type is found in the Great Lakes region of the United States and Canada, where it currently occupies limited portions of its former range. It is floristically similar to hemlock stands without extensive white pine, and this type is not always distinguished from that type. It was far more extensive as a canopy or supercanopy dominant in presettlement forests than it is today. In Wisconsin and Michigan, white pine is often a supercanopy relict only and has been logged out of most stands. As a result, old-growth stands that belong to this type are not known to be very extensive. This type may represent a long-lived transitional phase from a pine type to a hemlock type in the absence of further disturbance. It is perhaps the combination of substrate and disturbance dynamics that create a somewhat specific set of environmental factors. Further documentation of this type is needed.

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Global Comments: This description is based on the Great Lakes portion of the SAF cover type 22 (Eyre 1980). The type is currently not recognized in recent Ontario publications of forest types (Chambers et al. 1997, Bakowsky and Lee 1996, Lee et al. 1998), which seems surprising. In Wisconsin and Michigan, white pine is often a supercanopy relict only and has been logged out of most stands (E. Epstein, D. Albert pers. comm. 1996). Presence of *Picea rubens* (red spruce) may be a good indicator of the separate type, *Pinus strobus - Tsuga canadensis - Picea rubens* Forest (CEGL006324), in northern New England (and Quebec).
Global Similar Associations:
- *Pinus strobus - Tsuga canadensis - Picea rubens* Forest (CEGL006324)--a northeastern version of the same type.
- *Pinus strobus - Tsuga canadensis* Lower New England / Northern Piedmont Forest (CEGL006328)

Global Related Concepts:
- Mesic Northern Forest - Hemlock-White Pine (Chapman et al. 1989) =
- White Pine - Hemlock: 22 (Eyre 1980) B

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ELEMENT DISTRIBUTION

Global Range: This white pine - hemlock forest type is found in the Great Lakes region of the United States and Canada, ranging from northern Wisconsin and Michigan to central Ontario.
Nations: CA, US
States/Provinces: MI:S3, ON, WI:S2
TNC Ecoregions: 47:C, 48:C, 64:C
USFS Ecoregions (1994/95): 212Ea:CCC, 212Eb:CCC, 212Ee:CCC, 212Ha:CC?, 212Hb:CC?, 212He:CCP, 212Hh:CCP, 212Hi:CCC, 212Hj:CCC, 212Hk:CC?, 212Hl:CCC, 212Hm:CCP, 212Hn:CCP, 212Ho:CCC, 212Hp:CCP, 212Hq:CCP, 212Hr:CCP, 212Hu:CC?, 212Hv:CCP, 212Hw:CCP, 212Hx:CCP, 212Hy:CCC, 212Ia:CCC, 212Ja:CCC, 212Jb:CCP, 212Jc:CCC, 212Jj:CCC, 212Jl:CCC, 212Jm:CCC, 212Jn:CCP, 212Jo:CCP, 212Js:CCC, 222Ja:???
Federal Lands: NPS (Apostle Islands, Pictured Rocks); USFS (Chequamegon-Nicolet, Chequamegon?, Hiawatha, Huron, Huron-Manistee, Manistee, Nicolet, Ottawa)

ELEMENT SOURCES

Apostle Islands National Lakeshore Map Code: FWH
Local Description Authors:
Global Description Authors: J. Drake
References: Bakowsky and Lee 1996, Barnes 1991, Chambers et al. 1997, Chapman et al. 1989, Eyre 1980, Lee et al. 1998, Midwestern Ecology Working Group n.d., WNHIP unpubl. data

Aspen - Birch - Red Maple Forest

***Populus tremuloides - Betula papyrifera - (Acer rubrum, Populus grandidentata)* Forest**
Quaking Aspen - Paper Birch - (Red Maple, Bigtooth Aspen) Forest
Identifier: CEGL002467

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)	Aspen - Birch - Red Maple Forest
Ecological System(s):	Boreal Aspen-Birch Forest (CES103.020)
	Laurentian-Acadian Northern Hardwoods Forest (CES201.564)

ELEMENT CONCEPT

Global Summary: This aspen - birch - maple forest is found in the upper midwestern United States and southern and central Canada. Sites are on level to rolling topography, and on upper slopes or plateaus or in valley bottoms. The substrate is derived from glacial outwash, lacustrine deposits, or moraines. The soil is typically deep, sandy loam or loamy sand and well-drained. This deciduous forest community has a moderately closed canopy usually dominated by *Populus tremuloides* (quaking aspen) and *Betula papyrifera* (paper birch). *Acer rubrum* (red maple) and *Populus grandidentata* (bigtooth aspen) may be absent to dominant. Other minor components of the overstory may include *Abies balsamea* (balsam fir), *Pinus resinosa* (red pine), *Pinus strobus* (eastern white pine), *Picea glauca* (white spruce), and *Quercus rubra* (northern red oak). The shrub layer is approximately 2 m tall and often well-developed. The most abundant species are *Acer spicatum* (mountain maple), *Amelanchier* (serviceberry) spp., *Corylus cornuta* (beaked hazelnut), *Diervilla lonicera* (northern bush honeysuckle), and *Rosa acicularis* (prickly rose). Other shrubs present include *Lonicera canadensis* (American fly honeysuckle), *Rubus pubescens* (dwarf red blackberry), *Vaccinium angustifolium* (lowbush blueberry), and *Vaccinium myrtilloides* (velvetleaf huckleberry). The herbaceous layer tends to contain many species. Common species are *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Clintonia borealis* (bluebead), *Maianthemum canadense* (Canada mayflower), *Trientalis borealis* (starflower), and *Viola* (violet) spp.

ENVIRONMENTAL DESCRIPTION

Global Environment: This community is mostly found on level to rolling topography. It can occur on upper slopes or plateaus or in valley bottoms (Ohmann and Ream 1971). The soil is typically deep, sandy loam or loamy sand (Alban et al. 1991). The sites are on glacial outwash, lacustrine deposits, or moraines (Ohmann and Ream 1971, Sims et al. 1989). Most are well-drained, however, this community can be found on somewhat poorly drained sites.

VEGETATION DESCRIPTION

Global Vegetation: This deciduous forest community has a moderately closed canopy usually dominated by *Populus tremuloides* (quaking aspen) and *Betula papyrifera* (paper birch). *Acer rubrum* (red maple) and *Populus grandidentata* (bigtooth aspen) may be absent to dominant. Other minor components of the overstory may include *Abies balsamea* (balsam fir), *Pinus resinosa* (red pine), *Pinus strobus* (eastern white pine), *Picea glauca* (white spruce), and *Quercus rubra* (northern red oak). The shrub layer is approximately 2 m tall and often well-developed (MNNHP 1993). The most abundant species are *Acer spicatum* (mountain maple), *Amelanchier* (serviceberry) spp., *Corylus cornuta* (beaked hazelnut), *Diervilla lonicera* (northern bush honeysuckle), and *Rosa acicularis* (prickly rose). Other shrubs present include *Lonicera canadensis* (American fly honeysuckle), *Rubus pubescens* (dwarf red blackberry), *Vaccinium angustifolium* (lowbush blueberry), and *Vaccinium myrtilloides* (velvetleaf huckleberry). The herbaceous layer

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tends to contain many species. Common species include *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Clintonia borealis* (bluebead), *Maianthemum canadense* (Canada mayflower), *Trientalis borealis* (starflower), and *Viola* (violet) spp.

OTHER NOTEWORTHY SPECIES

Global: Other: *Trillium chloropetalum* var. *giganteum* (giant trillium, G5T3?)

CONSERVATION STATUS RANK

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

CLASSIFICATION

Status: Standard

Classification Confidence: 2 - Moderate

Global Comments: In Michigan, *Quercus rubra* (northern red oak) may be present. This type can result from removal of conifers by logging; e.g., Wisconsin does not track this type for conservation purposes because it most commonly establishes after logging of spruce-fir stands. Stands with understories of pines or mixed aspen-birch-pines best fit under the mixed evergreen-deciduous types (e.g., white pine - aspen - birch forest, *Pinus strobus - Populus tremuloides / Corylus cornuta* Forest (CEGL002479)).

Global Similar Associations:

- *Pinus strobus - Populus tremuloides / Corylus cornuta* Forest (CEGL002479)
- *Populus tremuloides - Betula papyrifera / (Abies balsamea, Picea glauca)* Forest (CEGL002466)
- *Populus tremuloides - Betula papyrifera / Acer saccharum* - Mixed Hardwoods Forest (CEGL002468)

Global Related Concepts:

- Aspen Hardwood (V5) (Sims et al. 1989) =
- Cloquet Site (Alban et al. 1991) =
- Dry-Mesic Northern Forest - Aspen-Birch (Chapman et al. 1989) =
- Maple (Yellow Birch) Hardwood and Mixedwood (V3.1) (Sims et al. 1997) =
- Maple - Aspen - Birch (Ohmann and Ream 1971) =

ELEMENT DISTRIBUTION

Global Range: This aspen - birch - maple forest is found in the upper midwestern United States and southern and central Canada, ranging from Minnesota and Manitoba east to Michigan, Ontario and possibly Quebec.

Nations: CA, US

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

TNC Ecoregions: 46:C, 47:C, 48:C

USFS Ecoregions (1994/95): 212Ha:CCP, 212Hb:CCP, 212He:CCP, 212Hh:CCP, 212Hi:CCC, 212Hj:CCP, 212Hk:CCP, 212Hl:CCC, 212Hn:CCP, 212Ho:CCC, 212Hp:CC?, 212Hw:CCC, 212Ia:CCC, 212Ib:CC?, 212Ja:CPP, 212Jb:CPP, 212Jc:CPP, 212Je:CPP, 212Jf:CPP, 212Jj:CPP, 212Jk:CPP, 212Jl:CPP, 212Jm:CPP, 212Jn:CPP, 212Jo:CPP, 212Jr:CPP, 212Ka:CCP, 212Kb:CCC, 212La:CCC, 212Mb:CCC, 212Na:CCP, 212Nb:CCP, 212Nc:CCC, 222Ma:CCC, 222Md:CCC

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

ELEMENT SOURCES

Apostle Islands National Lakeshore Map Code: FBR

Local Description Authors:

Global Description Authors: J. Drake

References: Alban et al. 1991, Chapman et al. 1989, MNNHP 1993, Midwestern Ecology Working Group n.d., Ohmann and Ream 1971, Sims et al. 1989, Sims et al. 1997, WNHIP unpubl. data

Aspen - Birch / Sugar Maple - Mixed Hardwoods Forest

***Populus tremuloides - Betula papyrifera / Acer saccharum* - Mixed Hardwoods Forest**

Quaking Aspen - Paper Birch / Sugar Maple - Mixed Hardwoods Forest

Identifier: CEGL002468

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)	Aspen - Birch / Sugar Maple - Mixed Hardwoods Forest

ELEMENT CONCEPT

Global Summary: This boreal aspen - birch forest type is found in the north-central United States and southern Canada on a variety of mesic upland locations. This community has been found on rich sites over clay or silt loam soils. Deciduous trees dominate the canopy and tree reproduction layers of this community. Conifers, when present, are widely scattered. Tree density is moderate to high, but substantial light penetrates the canopy due to the growth form of the dominant species, *Betula papyrifera* (paper birch) and *Populus tremuloides* (quaking aspen). Other northern hardwoods may be found in the canopy but are more common in the sapling

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layer. These include *Acer rubrum* (red maple), *Acer saccharum* (sugar maple), *Betula alleghaniensis* (yellow birch), *Fraxinus pennsylvanica* (green ash), *Ostrya virginiana* (hophornbeam), *Tilia americana* (American basswood), and *Ulmus americana* (American elm) (in more mesic sites). *Fagus grandifolia* (American beech) and *Tsuga canadensis* (eastern hemlock) become more common in eastern examples of this type. The shrub stratum is usually not well-developed due to shading from the canopy and subcanopy trees. Scattered *Acer spicatum* (mountain maple), *Corylus cornuta* (beaked hazelnut), *Diervilla lonicera* (northern bush honeysuckle) and *Rubus pubescens* (dwarf red blackberry) are typical shrubs. *Taxus canadensis* (Canada yew) and *Acer pensylvanicum* (striped maple) are present on some sites. The herbaceous layer contains species such as *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Clintonia borealis* (bluebead), *Maianthemum canadense* (Canada mayflower), *Oryzopsis asperifolia* (roughleaf ricegrass), and *Streptopus lanceolatus* var. *longipes* (twistedstalk). Mosses include *Dicranum flagellare* (dicranum moss), *Dicranum montanum* (Montane Dicranum Moss), and others.

ENVIRONMENTAL DESCRIPTION

Apostle Islands National Lakeshore Environment: This aspen - birch forest was sampled twice on Basswood Island and once near Little Sand Bay. Sites are found on west-, north- and northwest-facing midslopes. Soils are somewhat poorly drained loam and clay loam. The unvegetated surface is dominated by leaf litter (90-95% cover) with some wood (2-6%), bare soil (0-1%) standing water (0-2%) (following several days of torrential downpours at one site), and dead plant stems (2-5%). Evidence of disturbance includes trails and deadfalls.

Global Environment: This community is found on a variety of rich mesic sites over clay or silt loam soils. Alban et al. (1991) identified two examples of this community in Minnesota and upper Michigan. Both sites had 6 cm of organic material over the mineral soil. One site was on clay soil and the other on silt loam.

VEGETATION DESCRIPTION

Apostle Islands National Lakeshore Vegetation: The moderate (50% cover) tree canopy, 20-35 m tall, is dominated by *Populus grandidentata* (bigtooth aspen) and/or *Populus tremuloides* (quaking aspen) and may include lesser amounts of *Betula papyrifera* (paper birch) and *Quercus rubra* (northern red oak). The sparse (10-30%) subcanopy (10-20 m) includes *Abies balsamea* (balsam fir), *Acer saccharum* (sugar maple), and *Betula papyrifera* (paper birch). The sparse (20-30%) tall-shrub layer (2-5 m) is dominated by *Acer spicatum* (mountain maple) along with saplings of trees from the upper layers. The moderate (50-70%) short-shrub layer (0.5-1 m) is dominated by *Rubus parviflorus* (thimbleberry) and may include *Corylus cornuta* (beaked hazelnut), *Diervilla lonicera* (northern bush honeysuckle), and *Lonicera canadensis* (American fly honeysuckle). The moderate (50-60%) herbaceous layer includes dominants *Clintonia borealis* (bluebead), *Eurybia macrophylla* (bigleaf aster), and *Pteridium aquilinum* (western brackenfern); additional common species include *Aralia nudicaulis* (wild sarsaparilla), *Athyrium filix-femina* (common ladyfern), *Carex arctata* (drooping woodland sedge), *Galium triflorum* (fragrant bedstraw), *Lycopodium annotinum* (stiff clubmoss), *Maianthemum canadense* (Canada mayflower), and *Trientalis borealis* (starflower). Nonvascular species (mosses) cover 5% of the ground surface.

Global Vegetation: Deciduous trees dominate the canopy and tree reproduction layers of this community. Conifers, when present, are widely scattered. Tree density is moderate to high, but substantial light penetrates the canopy due to the growth form of the dominant species, *Betula papyrifera* (paper birch) and *Populus tremuloides* (quaking aspen). Other northern hardwoods may be found in the canopy but are more common in the sapling layer. These include *Acer rubrum* (red maple), *Acer saccharum* (sugar maple), *Betula alleghaniensis* (yellow birch), *Fraxinus pennsylvanica* (green ash), *Ostrya virginiana* (hophornbeam), *Tilia americana* (American basswood), and *Ulmus americana* (American elm) (in more mesic sites). *Fagus grandifolia* (American beech) and *Tsuga canadensis* (eastern hemlock) become more common in eastern examples of this type. The shrub stratum is usually not well-developed due to shading from the canopy and subcanopy trees. Scattered *Acer spicatum* (mountain maple), *Corylus cornuta* (beaked hazelnut), *Diervilla lonicera* (northern bush honeysuckle), and *Rubus pubescens* (dwarf red blackberry) are typical shrubs. *Taxus canadensis* (Canada yew) and *Acer pensylvanicum* (striped maple) are present on some sites. For example, Hansen et al. (1973) found *Taxus canadensis* (Canada yew) to be one of the more abundant shrubs on Isle Royale in Lake Superior. They also found this type to have the most diverse herbaceous layer of their sites. The herbaceous layer contains species such as *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Clintonia borealis* (bluebead), *Maianthemum canadense* (Canada mayflower), *Oryzopsis asperifolia* (roughleaf ricegrass), and *Streptopus lanceolatus* (twistedstalk). Mosses include *Dicranum flagellare* (dicranum moss), *Dicranum montanum* (Montane Dicranum Moss), and others (Chambers et al. 1997).

MOST ABUNDANT SPECIES

Apostle Islands National Lakeshore

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Populus grandidentata* (bigtooth aspen), *Populus tremuloides* (quaking aspen), *Quercus rubra* (northern red oak)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Acer spicatum* (mountain maple)
Short shrub/sapling	Broad-leaved deciduous shrub	*Rubus parviflorus* (thimbleberry)
Herb (field)	Forb	*Clintonia borealis* (bluebead), *Eurybia macrophylla* (bigleaf aster)

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Abies balsamea* (balsam fir), *Acer saccharum* (sugar maple), *Acer spicatum* (mountain maple), *Clintonia borealis* (bluebead), *Corylus cornuta* (beaked hazelnut), *Diervilla lonicera* (northern bush honeysuckle), *Eurybia macrophylla* (bigleaf aster), *Maianthemum canadense* (Canada mayflower), *Populus grandidentata* (bigtooth aspen), *Populus*

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tremuloides (quaking aspen), *Pteridium aquilinum* (western brackenfern), *Quercus rubra* (northern red oak), *Rubus parviflorus* (thimbleberry)

OTHER NOTEWORTHY SPECIES

Apostle Islands National Lakeshore: Exotic/Invasive: *Taraxacum officinale* (common dandelion, exotic)

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (3-Oct-1996). This type is probably more extensive today than it was prior to European settlement. For example, in Wisconsin, over half of the northern mesic forests - the hemlock hardwood and sugar maple types - have been converted to this type since about 1850.

CLASSIFICATION

Status: Standard

Classification Confidence: 2 - Moderate

Global Comments: This type includes stands dominated by a mixture of *Populus tremuloides* (quaking aspen) and *Betula papyrifera* (paper birch), with as little as 10% *Populus tremuloides* (quaking aspen). Pure stands of *Betula papyrifera* (paper birch) (>90%) are classified as a pure *Betula* (birch) type, *Betula papyrifera / Acer saccharum* - Mixed Hardwoods Forest (CEGL002464).

Global Similar Associations:

- *Betula papyrifera / Acer saccharum* - Mixed Hardwoods Forest (CEGL002464)--This is a pure *Betula papyrifera* type over hardwood regeneration.
- *Deschampsia caespitosa - (Sporobolus heterolepis, Schizachyrium scoparium) - Carex crawei - Packera paupercula* Herbaceous Vegetation (CEGL005110)--This is an aspen-birch type that lacks a diverse hardwood or a conifer understory.
- *Populus tremuloides - Betula papyrifera - (Acer rubrum, Populus grandidentata)* Forest (CEGL002467)
- *Populus tremuloides - Betula papyrifera / (Abies balsamea, Picea glauca)* Forest (CEGL002466)

Global Related Concepts:

- Baltimore Flats (Alban et al. 1991) F
- CNE mesic hardwood forest on acidic bedrock/till (Rawinski 1984) B
- Mesic Northern Forest - Hemlock-Sugar Maple (Chapman et al. 1989) B
- Paper Birch - Sugar Maple - Yellow Birch (Hansen et al. 1973) =
- Pike Bay (Alban et al. 1991) F
- Sugar Maple-White Birch-Red Maple-Fly Honeysuckle-Beaked Hazel (V13) (Chambers et al. 1997) ?
- Sugar Maple-White Birch-Trembling Aspen-Red Maple-Balsam Fir Shrub (V12) (Chambers et al. 1997) ?

ELEMENT DISTRIBUTION

Apostle Islands National Lakeshore Range: This aspen - birch forest occurs on Basswood Island and near Little Sand Bay.

Global Range: This boreal aspen - birch forest type is found in the north-central United States and southern Canada on a variety of mesic upland locations, ranging from Minnesota and Ontario east to Michigan.

Nations: CA, US

States/Provinces: MI, MN:S4?, ON, QC:S4S5, 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, 212Hm:CPP, 212Hn:CPP, 212Ho:CPP, 212Hq:CPP, 212Hr:CPP, 212Hs:CPP, 212Ht:CPP, 212Hv:CPP, 212Ia:CCC, 212Ib:CCP, 212Ja:CPP, 212Jb:CPP, 212Jc:CPP, 212Je:CPP, 212Jf:CPP, 212Jj:CPP, 212Jk:CPP, 212Jl:CPP, 212Jm:CPP, 212Jn:CPP, 212Jo:CPP, 212Jr:CPP, 212Ka:CPP, 212Lb:C??, 212Mb:CPP, 212Na:CPP, 212Nb:CPP, 212Nc:CPP

Federal Lands: NPS (Apostle Islands, Isle Royale, Saint Croix); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Huron, Huron-Manistee, Manistee, Nicolet, Ottawa)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (3 plots): APIS.306, APIS.324, APIS.325.

Apostle Islands National Lakeshore Map Code: FAM

Local Description Authors: M.J. Russo

Global Description Authors: J. Drake

References: Alban et al. 1991, Chambers et al. 1997, Chapman et al. 1989, Hansen et al. 1973, MNNHP 1993, Midwestern Ecology Working Group n.d., Rawinski 1984, WNHIP unpubl. data

Northern Red Oak - Sugar Maple Forest

***Quercus rubra - Acer saccharum - (Betula alleghaniensis)* Forest**

Northern Red Oak - Sugar Maple - (Yellow Birch) Forest

Identifier: CEGL002461

NVC CLASSIFICATION

Division	Eastern North American Cool Temperate Forest (1.C.2.a)
Macrogroup	Northern Hardwood & Conifer Forest (MG014)

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Group Northern Hardwood - Hemlock - White Pine Forest (G163)
Association (Common name) Northern Red Oak - Sugar Maple Forest
Ecological System(s): Laurentian-Acadian Pine-Hemlock-Hardwood Forest (CES201.563)

ELEMENT CONCEPT

Global Summary: This red oak - hardwood forest is found in the sub-boreal/mixed hardwood-conifer region of the Great Lakes, in both the United States and Canada. Stands are found on dry to mesic ridgetops and upper to midslopes, occasionally with bedrock outcrops, and on glacial outwash. Soils are moderately shallow (30-60 cm) to deep, varying from fine sands to loams and clay loams. Dominant species in the tree canopy include *Quercus rubra* (northern red oak), *Acer saccharum* (sugar maple), and *Acer rubrum* (red maple). Associates include *Betula papyrifera* (paper birch), *Betula alleghaniensis* (yellow birch), *Pinus strobus* (eastern white pine), *Populus tremuloides* (quaking aspen), *Populus grandidentata* (bigtooth aspen), and in the eastern part of its range, *Fagus grandifolia* (American beech), *Fraxinus americana* (white ash), and *Ostrya virginiana* (hophornbeam). Subcanopy species typically include the maples. Shrubs include *Amelanchier laevis* (Allegheny serviceberry), *Acer pensylvanicum* (striped maple), *Corylus cornuta* (beaked hazelnut), *Hamamelis virginiana* (American witch-hazel), and *Lonicera canadensis* (American fly honeysuckle). Herbs include *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Dryopteris carthusiana* (spinulose woodfern), *Maianthemum canadense* (Canada mayflower), *Mitchella repens* (partridgeberry) (creeping semi-shrub), *Polygonatum pubescens* (hairy Solomon's seal), and *Pteridium aquilinum* (western brackenfern). Diagnostic species include *Quercus rubra* (northern red oak) along with ground layer species typical of the mixed hardwood-conifer region.

ENVIRONMENTAL DESCRIPTION

Apostle Islands National Lakeshore Environment: This red oak - sugar maple forest was sampled at six locations in the park: Basswood Island (2 sites), Oak Island (1), and Stockton Island (3). Sites range from gentle to moderate mid- to upper slope ridges and moraines of glacial till with northern, southern, and southeastern aspects reported. Recorded elevations range from 180 to 260 m (586-854 feet). Soils include moderately well- and well-drained loam, loamy sand, sandy loam and sand. The unvegetated surface is dominated by leaf litter (80-100% cover) with some wood (0-20%). Evidence of disturbance includes faint trails and downed wood.
Global Environment: Stands are found on glacial till (end and ground moraines), mesic portions of glacial outwash and glacial lakebeds, and, farther north, on dry to mesic ridgetops and upper to midslopes, occasionally with bedrock outcrops. Soils are moderately shallow (30-60 cm) to deep, varying from fine sands to loams and clay loams (Nowacki et al. 1990, Chambers et al. 1997). Site characteristics are well-described in central Ontario by Chambers et al. (1997) (ecosites 23.1 and 23.2).

VEGETATION DESCRIPTION

Apostle Islands National Lakeshore Vegetation: The moderate to very dense (60-90% cover) tree canopy, 20-35 m tall, is dominated by *Acer saccharum* (sugar maple) and *Quercus rubra* (northern red oak); additional canopy species include *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), and *Populus tremuloides* (quaking aspen). The sparse to moderate (30-50%) subcanopy (15-20 m) is made up of canopy species and may include *Ostrya virginiana* (hophornbeam) and *Tsuga canadensis* (eastern hemlock). The very sparse to moderately dense (5-70%) tall-shrub layer (2-5 m) may include *Acer spicatum* (mountain maple), *Amelanchier* (serviceberry) sp., *Corylus cornuta* (beaked hazelnut), *Ostrya virginiana* (hophornbeam), and *Sorbus decora* (northern mountain-ash). The sparse (5-20%) short-shrub layer (0.5-2 m) includes tall-shrub species as well as *Lonicera canadensis* (American fly honeysuckle). The variable herbaceous layer (5-60%) includes *Aralia nudicaulis* (wild sarsaparilla), *Carex arctata* (drooping woodland sedge), *Clintonia borealis* (bluebead), *Dryopteris intermedia* (intermediate woodfern), *Eurybia macrophylla* (bigleaf aster), *Maianthemum canadense* (Canada mayflower), *Moneses uniflora* (single delight), *Monotropa uniflora* (Indianpipe), *Pteridium aquilinum* (western brackenfern), *Streptopus lanceolatus* var. *roseus* (twistedstalk), and *Trientalis borealis* (starflower).
Global Vegetation: The canopy is dominated by deciduous trees. Dominant species in the canopy include *Quercus rubra* (northern red oak), *Acer saccharum* (sugar maple), and *Acer rubrum* (red maple). Associates include *Betula papyrifera* (paper birch), *Betula alleghaniensis* (yellow birch), *Pinus strobus* (eastern white pine), *Populus tremuloides* (quaking aspen), *Populus grandidentata* (bigtooth aspen), and in the eastern part of its range, *Fagus grandifolia* (American beech), *Fraxinus americana* (white ash), and *Ostrya virginiana* (hophornbeam). Subcanopy species typically include the maples. Shrubs include *Amelanchier laevis* (Allegheny serviceberry), *Acer pensylvanicum* (striped maple), *Corylus cornuta* (beaked hazelnut), and *Lonicera canadensis* (American fly honeysuckle). Herbs include *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Dryopteris carthusiana* (spinulose woodfern), *Maianthemum canadense* (Canada mayflower), *Mitchella repens* (partridgeberry) (creeping semi-shrub), *Polygonatum pubescens* (hairy Solomon's seal), and *Pteridium aquilinum* (western brackenfern). Diagnostic species include *Quercus rubra* (northern red oak) with ground layer species typical of the mixed hardwood/conifer region (Chambers et al. 1997).

MOST ABUNDANT SPECIES

Apostle Islands National Lakeshore

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Quercus rubra* (northern red oak)
Tree canopy	Broad-leaved deciduous tree	*Acer saccharum* (sugar maple)

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Acer rubrum* (red maple), *Acer saccharum* (sugar maple), *Acer spicatum* (mountain maple), *Aralia nudicaulis* (wild sarsaparilla), *Betula alleghaniensis* (yellow birch), *Corylus cornuta* (beaked hazelnut), *Dryopteris intermedia* (intermediate woodfern), *Eurybia macrophylla* (bigleaf aster), *Lonicera canadensis* (American fly honeysuckle), *Maianthemum*

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canadense (Canada mayflower), *Ostrya virginiana* (hophornbeam), *Quercus rubra* (northern red oak), *Streptopus lanceolatus* var. *roseus* (twistedstalk), *Trientalis borealis* (starflower)

CONSERVATION STATUS RANK

Global Rank & Reasons: G4G5 (14-Aug-2009). This type often arises after logging or logging and fire, and may be as common, or more so, as it was prior to European settlement.

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Global Comments: This association is similar to *Quercus rubra - (Acer saccharum, Quercus alba)* Forest (CEGL005017), which is more southerly and lacks northern trees such as *Betula alleghaniensis* (yellow birch) and possibly *Betula papyrifera* (paper birch). This association (CEGL002461) is found in Province 212 while CEGL005017 is limited to Province 222. See also *Quercus rubra - Acer saccharum - Fagus grandifolia / Viburnum acerifolium* Forest (CEGL006173) in the East. Compare with *Quercus rubra - Quercus alba - (Quercus velutina, Acer rubrum) / Viburnum acerifolium* Forest (CEGL002462), which is more dry. Because the type is thought to have originated through logging and burning of pine stands (at least in Minnesota), its composition is fairly generic. In the Manistee National Forest ecological land type classification, see ELTP 40, 42, 43 (Cleland et al. 1994).
Global Similar Associations:
- *Acer saccharum - Betula alleghaniensis - Quercus rubra / Viburnum acerifolium* Forest (CEGL006943)--is found in the northeastern United States.
- *Acer saccharum - Fagus grandifolia - Betula* spp. / *Maianthemum canadense* Forest (CEGL005004)
- *Quercus rubra - (Acer saccharum, Quercus alba)* Forest (CEGL005017)--is found south of CEGL002461 in Province 222.
- *Quercus rubra - Acer saccharum - Fagus grandifolia / Viburnum acerifolium* Forest (CEGL006173)--is found in the northeastern United States.
- *Quercus rubra - Quercus alba - (Quercus velutina, Acer rubrum) / Viburnum acerifolium* Forest (CEGL002462)

Global Related Concepts:
- Mesic Northern Forest - Beech-Sugar Maple-Yellow Birch (Chapman et al. 1989) ?
- Red Oak-Sugar Maple-Ironwood-Fly Honeysuckle (V6) (Chambers et al. 1997) =

ELEMENT DISTRIBUTION

Apostle Islands National Lakeshore Range: This red oak - sugar maple forest occurs on Basswood, Oak, and Stockton islands.
Global Range: This red oak-hardwood community is found in the sub-boreal/mixed hardwood-conifer region of the Great Lakes, in both the United States and Canada, ranging from northeastern Minnesota east to Wisconsin, Michigan, and Ontario.
Nations: CA, US
States/Provinces: MI, MN:S3, ON, QC:S4?, WI
TNC Ecoregions: 47:C, 48:C
USFS Ecoregions (1994/95): 212Hc:CCC, 212Ho:CCC, 212Hw:CCC, 212Ia:CCC, 212Jd:CCC, 212Jj:CCC, 212Jl:CC?, 212K:CC, 212Lb:CCC, 212Na:C??, 212Nb:C??
Federal Lands: NPS (Apostle Islands, Isle Royale, Saint Croix, Sleeping Bear Dunes); USFS (Chequamegon-Nicolet?, Chequamegon?, Chippewa?, Huron-Manistee?, Huron?, Manistee?, Nicolet?)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (6 plots): APIS.024, APIS.108, APIS.312, APIS.313, APIS.501, APIS.503.
Apostle Islands National Lakeshore Map Code: FOM
Local Description Authors: M.J. Russo
Global Description Authors: D. Faber-Langendoen, mod. J. Drake
References: Chambers et al. 1997, Chapman et al. 1989, Cleland et al. 1994, Kost et al. 2007, MNNHP 1993, Midwestern Ecology Working Group n.d., Nowacki et al. 1990, WNHIP unpubl. data

White-cedar - Boreal Conifer Mesic Forest

***Thuja occidentalis / Abies balsamea - Acer spicatum* Forest**
Northern White-cedar / Balsam Fir - Mountain Maple Forest
Identifier: CEGL002449

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
Ecological System(s):	Laurentian-Acadian Northern Hardwoods Forest (CES201.564)

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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

Apostle Islands National Lakeshore Environment: This upland white-cedar - hardwood forest was sampled at 13 locations in the park: Sand Point on the mainland unit (4 sites), Bear Island (3), Devils Island (2), Raspberry Island (3), and Sand Island (1). Sites range from gentle midslopes of nearly any aspect to flat step-in-slopes and summits of moraines. Elevations range from 190 to 235 m (622-772 feet). Soils range from moderately well- to well-drained loam, silt loam, sandy loam, loamy sand, and sand. The unvegetated surface is dominated by leaf litter (70-97% cover) with some wood (3-30%) and bare soil (0-4%). Evidence of disturbance includes trails, wind damage (blowdowns and tip-up mounds), and possible past tree cutting.

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

Apostle Islands National Lakeshore Vegetation: The moderate to dense (50-80% cover) tree canopy, 10-35 m tall, is dominated by *Betula alleghaniensis* (yellow birch) and *Thuja occidentalis* (northern white-cedar); additional canopy species in lesser amounts may include *Abies balsamea* (balsam fir), *Acer rubrum* (red maple), *Acer saccharum* (sugar maple), *Betula papyrifera* (paper birch), *Sorbus decora* (northern mountain-ash), and *Tilia americana* (American basswood). One stand has a moderate (40%) emergent canopy (35-50 m) of *Pinus strobus* (eastern white pine). The sparse to moderate (10-50%) subcanopy (5-20 m) is dominated by *Acer spicatum* (mountain maple) and may also include *Abies balsamea* (balsam fir) and *Thuja occidentalis* (northern white-cedar). The very sparse to moderate (5-60%) tall-shrub layer (1-5 m) is dominated by *Acer spicatum* (mountain maple), and the very sparse to dense (5-80%) short-shrub layer (0.5-2 m) is dominated by *Taxus canadensis* (Canada yew). Dominants in the very sparse to moderate herbaceous layer (5-60%) include *Clintonia borealis* (bluebead), *Dryopteris intermedia* (intermediate woodfern), *Huperzia lucidula* (shining clubmoss), *Maianthemum canadense* (Canada mayflower), *Oxalis montana* (mountain woodsorrel), and *Trientalis borealis* (starflower); a total of 41 taxa were recorded from 12 plots. Nonvascular species (mosses and lichens) cover 5-10% of the ground surface.

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* (twinflower), *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).

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MOST ABUNDANT SPECIES

Apostle Islands National Lakeshore

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Needle-leaved tree	*Thuja occidentalis* (northern white-cedar)
Tree canopy	Needle-leaved tree	*Abies balsamea* (balsam fir)
Tree canopy	Broad-leaved deciduous tree	*Betula alleghaniensis* (yellow birch), *Betula papyrifera* (paper birch)
Tree subcanopy	Broad-leaved deciduous tree	*Acer spicatum* (mountain maple)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Acer spicatum* (mountain maple)
Short shrub/sapling	Needle-leaved shrub	*Taxus canadensis* (Canada yew)
Herb (field)	Fern or fern ally	*Dryopteris intermedia* (intermediate woodfern)

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Abies balsamea* (balsam fir), *Acer spicatum* (mountain maple), *Betula alleghaniensis* (yellow birch), *Betula papyrifera* (paper birch), *Clintonia borealis* (bluebead), *Dryopteris intermedia* (intermediate woodfern), *Huperzia lucidula* (shining clubmoss), *Maianthemum canadense* (Canada mayflower), *Oxalis montana* (mountain woodsorrel), *Taxus canadensis* (Canada yew), *Thuja occidentalis* (northern white-cedar), *Trientalis borealis* (starflower)

OTHER NOTEWORTHY SPECIES

Apostle Islands National Lakeshore: Exotic/Invasive: *Galeopsis tetrahit* (brittlestem hempnettle, exotic)

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-Twinflower (V21) (Chambers et al. 1997) =

ELEMENT DISTRIBUTION

Apostle Islands National Lakeshore Range: This upland white-cedar - hardwood forest occurs on Sand Point on the mainland unit, Bear Island, Devils Island, Raspberry Island, and Sand Island.
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, 212Hl: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)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (13 plots): APIS.019, APIS.033, APIS.035, APIS.125, APIS.136, APIS.210, APIS.211, APIS.307, APIS.308, APIS.309, APIS.310, APIS.331, APIS.332.
Apostle Islands National Lakeshore Map Code: FCC, FCM
Local Description Authors: M.J. Russo

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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, WNHIP unpubl. data

Hemlock Mesic Forest

***Tsuga canadensis* - *(Betula alleghaniensis)* Forest**
Eastern Hemlock - (Yellow Birch) Forest
Identifier: CEGL002598

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)	Hemlock Mesic Forest
Ecological System(s):	Laurentian-Acadian Pine-Hemlock-Hardwood Forest (CES201.563)

ELEMENT CONCEPT

Global Summary: This mesic hemlock evergreen forest is found in the Great Lakes region of the United States and Canada. Stands occur on deep, acidic soils that may be poorly drained. The overstory of this community is strongly dominated by *Tsuga canadensis* (eastern hemlock), typically around 25 m tall. *Betula alleghaniensis* (yellow birch) is often present in the canopy and subcanopy, but at less than 25% cover. Other species that are a minor component of the canopy include *Abies balsamea* (balsam fir), *Acer rubrum* (red maple), *Acer saccharum* (sugar maple), *Pinus strobus* (eastern white pine), *Tilia americana* (American basswood), and *Thuja occidentalis* (northern white-cedar). The sapling layer may also contain *Abies balsamea* (balsam fir) and *Thuja occidentalis* (northern white-cedar), especially in canopy gaps. Shrubs are rare and herbaceous species only moderately abundant under the dense evergreen canopy; however, where gaps occur, *Acer pensylvanicum* (striped maple), *Acer spicatum* (mountain maple), *Amelanchier* (serviceberry) spp., *Gaultheria procumbens* (eastern teaberry), *Lonicera canadensis* (American fly honeysuckle), and *Rubus idaeus* (American red raspberry) may be moderately abundant. The herbaceous layer is poor under drier, more evergreen stands, and richer under more moist and somewhat deciduous stands. Herbaceous species found in this community include *Aralia nudicaulis* (wild sarsaparilla), *Clintonia borealis* (bluebead), *Coptis trifolia* (threeleaf goldthread), *Cornus canadensis* (bunchberry dogwood), *Dryopteris carthusiana* (spinulose woodfern), *Huperzia lucidula* (shining clubmoss), *Maianthemum canadense* (Canada mayflower), *Oxalis montana* (mountain woodsorrel), *Pteridium aquilinum* (western brackenfern), *Streptopus lanceolatus* var. *longipes* (twistedstalk), and *Trientalis borealis* (starflower). A sparse to dense moss layer includes *Brachythecium reflexum* (brachythecium moss), *Callicladium haldanianum* (callicladium moss), *Dicranum flagellare* (dicranum moss), *Dicranum montanum* (Montane Dicranum Moss), *Mnium marginatum* (olivegreen calcareous moss), *Plagiothecium laetum* (plagiothecium moss), *Polytrichum commune* (polytrichum moss), *Ptilidium pulcherrimum*, and *Tetraphis pellucida* (tetraphis moss).

ENVIRONMENTAL DESCRIPTION

Apostle Islands National Lakeshore Environment: This hemlock forest was sampled only once on the western end of Michigan Island. The site is a gently sloping bench at 193 m (633 feet) elevation. The soil is well-drained sand. The unvegetated surface is made up leaf litter (65% cover) and wood (35%). No evidence of disturbance was reported.

Global Environment: This community is found on acidic soils that may be poorly drained. Coffman and Willis (1977) found this community on sandy loam and loams that averaged 115 cm deep and had a fragipan at 45-70 cm. This community may be found on shallow soils in the Huron Mountains of upper Michigan (P. Comer pers. comm. 1996).

VEGETATION DESCRIPTION

Apostle Islands National Lakeshore Vegetation: The moderate (50% cover) tree canopy, 20-35 m tall, is made up of *Tsuga canadensis* (eastern hemlock), the sparse (20%) subcanopy (10-15 m) of *Abies balsamea* (balsam fir) and *Betula papyrifera* (paper birch). The sparse (10%) tall-shrub layer (2-5 m) includes saplings *Abies balsamea* (balsam fir) and *Tsuga canadensis* (eastern hemlock). The very sparse (5%) short-shrub layer (0.5-1 m) contains *Nemopanthus mucronatus* (catberry) and *Sorbus decora* (northern mountain-ash). The sparse herbaceous layer (10%) includes tree seedlings, along with *Clintonia borealis* (bluebead), *Maianthemum canadense* (Canada mayflower), *Melampyrum lineare* (narrowleaf cowwheat), *Monotropa uniflora* (Indianpipe), *Pteridium aquilinum* (western brackenfern), and *Ptilium crista-castrensis* (knights plume moss). The ground surface has a dense cover (80%) of nonvascular species (mosses and lichens) mostly *Pleurozium schreberi* (Schreber's big red stem moss).

Global Vegetation: The overstory of this community is strongly dominated by *Tsuga canadensis* (eastern hemlock), typically around 25 m tall (Martin 1959a). *Betula alleghaniensis* (yellow birch) is often present in the canopy and subcanopy, but at less than 25% cover. Other species that are a minor component of the canopy include *Abies balsamea* (balsam fir), *Acer rubrum* (red maple), *Acer saccharum* (sugar maple), *Pinus strobus* (eastern white pine), *Tilia americana* (American basswood), and *Thuja occidentalis* (northern white-cedar). The sapling layer may also contain *Abies balsamea* (balsam fir) and *Thuja occidentalis* (northern white-cedar), especially in canopy gaps (Martin 1959a). Shrubs are rare and herbaceous species only moderately abundant under the dense evergreen canopy; however, where gaps occur, *Acer pensylvanicum* (striped maple), *Acer spicatum* (mountain maple), *Amelanchier* (serviceberry) spp., *Gaultheria procumbens* (eastern teaberry), *Lonicera canadensis* (American fly honeysuckle), and *Rubus idaeus*

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(American red raspberry) may be moderately abundant. The herbaceous layer is poor under drier, more evergreen stands, and richer under more moist and somewhat deciduous stands. Herbaceous species found in this community include *Aralia nudicaulis* (wild sarsaparilla), *Clintonia borealis* (bluebead), *Coptis trifolia* (threeleaf goldthread), *Cornus canadensis* (bunchberry dogwood), *Dryopteris carthusiana* (spinulose woodfern), *Huperzia lucidula* (shining clubmoss), *Maianthemum canadense* (Canada mayflower), *Oxalis montana* (mountain woodsorrel), *Pteridium aquilinum* (western brackenfern), *Streptopus lanceolatus* (twistedstalk), and *Trientalis borealis* (starflower). A sparse to dense moss layer includes *Brachythecium reflexum* (brachythecium moss), *Callicladium haldanianum* (callicladium moss), *Dicranum flagellare* (dicranum moss), *Dicranum montanum* (Montane Dicranum Moss), *Mnium marginatum* (olivegreen calcareous moss), *Plagiothecium laetum* (plagiothecium moss), *Polytrichum commune* (polytrichum moss), *Ptilidium pulcherrimum*, and *Tetraphis pellucida* (tetraphis moss). Liverworts may include *Bazzania trilobata* and *Jamesoniella autumnalis* (Chambers et al. 1997).

MOST ABUNDANT SPECIES

Apostle Islands National Lakeshore

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Tsuga canadensis* (eastern hemlock)
Nonvascular	Moss	*Pleurozium schreberi* (Schreber's big red stem moss)

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Abies balsamea* (balsam fir), *Clintonia borealis* (bluebead), *Maianthemum canadense* (Canada mayflower), *Pleurozium schreberi* (Schreber's big red stem moss), *Pteridium aquilinum* (western brackenfern), *Ptilium crista-castrensis* (knights plume moss), *Tsuga canadensis* (eastern hemlock)

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G4 (24-Oct-2002). This mesic hemlock evergreen forest has a moderately wide range, being found fairly commonly in the Great Lakes region of the United States and Canada. It does not require particularly specific environmental factors, and there may be a large number of Element Occurrences. Under natural conditions many stands would be expected to be in a variety of old-growth conditions, but, at this time, the area occupied by such stands is a relatively small percentage of their former area (Frelich 1995).

CLASSIFICATION

Status: Standard
Classification Confidence: 1 - Strong
Global Comments: This type varies from almost pure *Tsuga canadensis* (eastern hemlock) to more of a mix with *Betula alleghaniensis* (yellow birch), but the deciduous component is generally less than 25% cover (see e.g., Chambers et al. 1997, Ecosite 30.1 and 30.2). If hardwoods exceed 25%, the type is placed in *Tsuga canadensis - Acer saccharum - Betula alleghaniensis* Forest (CEGL005044), but logged stands, or remnants that occur in a matrix of secondary growth hardwoods, can be difficult to assign. Chambers et al. (1997) recognize a moist and a dry type in central Ontario. Those are treated as variants of the one type here. In Michigan this type is on the clay lakeplain in the western Upper Peninsula and in the Saginaw Bay Lakeplain. The data by Rogers (1980), who examined pure hemlock stands (many of them less than 2 ha in size) from Wisconsin to Nova Scotia, make clear that there are few species strictly associated with a pure hemlock versus a mixed hemlock-hardwood type, and also indicate that some distinction between a Great Lakes versus northeastern United States/eastern Canada has some merit, as done for the mixed hemlock-hardwood type (CEGL005044 versus *Tsuga canadensis - (Betula alleghaniensis) - Picea rubens / Cornus canadensis* Forest (CEGL006129)). No pure evergreen hemlock type is currently recognized in the northeast because of its small patch size.
Global Similar Associations:
- *Tsuga canadensis - Acer saccharum - Betula alleghaniensis* Forest (CEGL005044)

Global Related Concepts:
- *Tsuga-Coptis* Association (Coffman and Willis 1977) =
- *Tsuga* Forest, Stands He1 and He2 (Martin 1959a) =
- CNE mesic conifer [transition] forest on acidic bedrock/till (Rawinski 1984) B
- Eastern Hemlock: 23 (Eyre 1980) B
- Hemlock - Yellow Birch: 24 (Eyre 1980) B
- Hemlock Forest (Thompson 1996) B
- Hemlock-Spinulose Wood Fern-Herb Poor (V19) (Chambers et al. 1997) F
- Hemlock-Yellow Birch-Goldthread-Wood Sorrel (V18) (Chambers et al. 1997) F
- Mesic Northern Forest - Hemlock-Yellow Birch (Chapman et al. 1989) =

ELEMENT DISTRIBUTION

Apostle Islands National Lakeshore Range: This hemlock forest was sampled on the western end of Michigan Island.
Global Range: This mesic hemlock evergreen forest is found in the Great Lakes region of the United States and Canada, ranging from Wisconsin and Michigan to Ontario. Range extent is about 300,000 square km.
Nations: CA, US
States/Provinces: MI:S3, ON, WI:S3S4
TNC Ecoregions: 46:C, 47:C, 48:C

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USFS Ecoregions (1994/95): 212Hb:CC?, 212Hh:CCP, 212Hi:CCC, 212Hl:CCC, 212Ho:CCC, 212Hw:CCC, 212Ia:CCC, 212Ja:CCC, 212Jb:CCC, 212Jc:CCC, 212Je:CCC, 212Jf:CCC, 212Jj:CCC, 212Jl:CCC, 212Jm:CCC, 212Jn:CCP, 212Jo:CCP, 212Js:CCC, 222Ja:CCC, 222Je:CCC, 222Ld:CCC
Federal Lands: NPS (Apostle Islands, Pictured Rocks, Sleeping Bear Dunes); USFS (Chequamegon-Nicolet, Chequamegon?, Hiawatha?, Nicolet, Ottawa)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (1 plot): APIS.119.
Apostle Islands National Lakeshore Map Code: FHC
Local Description Authors: M.J. Russo
Global Description Authors: J. Drake
References: Chambers et al. 1997, Chapman et al. 1989, Coffman and Willis 1977, Comer pers. comm., Eyre 1980, Frelich 1995, Frelich and Lorimer 1991a, Martin 1959a, Midwestern Ecology Working Group n.d., Rawinski 1984, Rogers 1980, Thompson 1996, Thompson and Sorenson 2000, Tyrrell and Crow 1994, WNHIP unpubl. data

North-Central Hemlock - Hardwood Forest

***Tsuga canadensis* - *Acer saccharum* - *Betula alleghaniensis* Forest**
Eastern Hemlock - Sugar Maple - Yellow Birch Forest
Identifier: CEGL005044

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)	North-Central Hemlock - Hardwood Forest
Ecological System(s):	Laurentian-Acadian Pine-Hemlock-Hardwood Forest (CES201.563)

ELEMENT CONCEPT

Global Summary: This hemlock - hardwoods forest is found in the northern Great Lakes region of the United States and Canada. Sites are dry-mesic, typically coarse- to medium-textured ground and end moraines, but also silty/clayey lakeplains, thin glacial till over bedrock, and sand dunes. Soils are loamy sand to sandy loam, with moderately acidic soils. The tree canopy is dominated by a mix of evergreen and deciduous species. *Acer saccharum* (sugar maple), *Betula alleghaniensis* (yellow birch), and *Tsuga canadensis* (eastern hemlock) dominate the canopy. Canopy associates include *Acer rubrum* (red maple). Shrub cover is moderate to sparse, including species such as *Acer pensylvanicum* (striped maple) (eastward), *Acer spicatum* (mountain maple), *Corylus cornuta* (beaked hazelnut), *Sambucus racemosa* var. *racemosa* (red elderberry), and *Viburnum lantanoides* (hobblebush) (eastward). Typical herbs include *Actaea pachypoda* (white baneberry), *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Carex arctata* (drooping woodland sedge), *Clintonia borealis* (bluebead), *Dryopteris carthusiana* (spinulose woodfern), *Galium triflorum* (fragrant bedstraw), *Lycopodium dendroideum* (tree groundpine), *Maianthemum canadense* (Canada mayflower), *Medeola virginiana* (Indian cucumber), *Mitella nuda* (naked miterwort), *Osmorhiza claytonii* (Clayton's sweetroot), *Polygonatum pubescens* (hairy Solomon's seal), *Streptopus lanceolatus* var. *longipes* (twistedstalk), *Trientalis borealis* (starflower), *Trillium erectum* (red trillium), and *Trillium grandiflorum* (snow trillium). Mosses include *Brachythecium reflexum* (brachythecium moss), *Callicladium haldanianum* (callicladium moss), *Dicranum montanum* (Montane Dicranum Moss), and *Plagiothecium laetum* (plagiothecium moss).

ENVIRONMENTAL DESCRIPTION

Apostle Islands National Lakeshore Environment: This hemlock - hardwoods community is one of the most common in the park and was sampled at 13 locations. These include Bear Island (2 sites), Oak Island (2), Outer Island (5), Sand Island (1), and Stockton Island (4). Sites are generally flat to gently sloping moraines and lakeplains. Elevations range from 193 to 326 m (633-1070 feet). Soils range from moderately well- to well-drained loam, silt loam, loamy sand, sandy loam and sand. The unvegetated surface is dominated by leaf litter (70-99% cover) with some wood (0-30%). Evidence of disturbance includes wind damage (blowdowns) and past quarrying activities at one site.
Global Environment: Sites are dry-mesic, typically coarse- to medium-textured ground and end moraines, but also silty/clayey lakeplains, thin glacial till over bedrock, and sand dunes. Soils are loamy sand to sandy loam, with moderately acidic soils.

VEGETATION DESCRIPTION

Apostle Islands National Lakeshore Vegetation: The moderate to dense (50-80% cover) tree canopy, 20-50 m tall, is dominated by *Betula alleghaniensis* (yellow birch) and *Tsuga canadensis* (eastern hemlock), and may include lesser amounts of *Acer rubrum* (red maple), *Acer saccharum* (sugar maple), *Betula papyrifera* (paper birch), *Pinus strobus* (eastern white pine), *Quercus rubra* (northern red oak), and/or *Thuja occidentalis* (northern white-cedar). The very sparse to moderate (5-60%) subcanopy (10-20 m) is dominated by *Tsuga canadensis* (eastern hemlock) and *Thuja occidentalis* (northern white-cedar). The very sparse to moderate (5-60%) tall-shrub layer (1-5 m) is made up of *Acer spicatum* (mountain maple), *Thuja occidentalis* (northern white-cedar), and *Tsuga canadensis* (eastern hemlock), and the very sparse to moderately dense (5-70%) short-shrub layer (0.5-2 m) is dominated by *Taxus canadensis* (Canada yew). The very sparse to moderate (5-70%) herbaceous layer includes *Aralia nudicaulis* (wild sarsaparilla), *Clintonia borealis* (bluebead), *Dryopteris intermedia* (intermediate woodfern), *Huperzia lucidula* (shining clubmoss), and *Maianthemum*

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canadense (Canada mayflower). Nonvascular species (mosses), including *Pleurozium schreberi* (Schreber's big red stem moss) and *Sphagnum* (sphagnum) spp., cover 5-40% of the ground surface. In addition, state-imperiled (S2) *Goodyera oblongifolia* (western rattlesnake plantain) and state-vulnerable (S3) *Osmorhiza berteroi* (sweetcicely) were recorded in the sampled plots.

Global Vegetation: The tree canopy is dominated by a mix of evergreen and deciduous species. *Acer saccharum* (sugar maple), *Betula alleghaniensis* (yellow birch), and *Tsuga canadensis* (eastern hemlock) dominate the canopy. Canopy associates include *Acer rubrum* (red maple). Shrub cover is moderate to sparse, including species such as *Acer pensylvanicum* (striped maple) (eastward), *Acer spicatum* (mountain maple), *Corylus cornuta* (beaked hazelnut), *Sambucus racemosa* var. *racemosa* (red elderberry), and *Viburnum lantanoides* (hobblebush) (eastward). Typical herbs include *Actaea pachypoda* (white baneberry), *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Carex arctata* (drooping woodland sedge), *Clintonia borealis* (bluebead), *Dryopteris carthusiana* (spinulose woodfern), *Galium triflorum* (fragrant bedstraw), *Lycopodium dendroideum* (tree groundpine), *Maianthemum canadense* (Canada mayflower), *Medeola virginiana* (Indian cucumber), *Mitella nuda* (naked miterwort), *Osmorhiza claytonii* (Clayton's sweetroot), *Polygonatum pubescens* (hairy Solomon's seal), *Streptopus lanceolatus* (twistedstalk), *Trientalis borealis* (starflower), *Trillium erectum* (red trillium), and *Trillium grandiflorum* (snow trillium). Mosses include *Brachythecium reflexum* (brachythecium moss), *Callicladium haldanianum* (callicladium moss), *Dicranum montanum* (Montane Dicranum Moss), and *Plagiothecium laetum* (plagiothecium moss) (Curtis 1959, Chapman et al. 1989, Chambers et al. 1997).

MOST ABUNDANT SPECIES

Apostle Islands National Lakeshore

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Needle-leaved tree	*Thuja occidentalis* (northern white-cedar), *Tsuga canadensis* (eastern hemlock)
Tree canopy	Broad-leaved deciduous tree	*Betula alleghaniensis* (yellow birch)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Acer spicatum* (mountain maple)
Short shrub/sapling	Needle-leaved shrub	*Taxus canadensis* (Canada yew)

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Acer spicatum* (mountain maple), *Aralia nudicaulis* (wild sarsaparilla), *Betula alleghaniensis* (yellow birch), *Dryopteris intermedia* (intermediate woodfern), *Maianthemum canadense* (Canada mayflower), *Pleurozium schreberi* (Schreber's big red stem moss), *Taxus canadensis* (Canada yew), *Thuja occidentalis* (northern white-cedar), *Tsuga canadensis* (eastern hemlock)

OTHER NOTEWORTHY SPECIES

Apostle Islands National Lakeshore: Vulnerable: *Goodyera oblongifolia* (western rattlesnake plantain, state-imperiled, G5?), *Osmorhiza berteroi* (sweetcicely, state-vulnerable, G5); **Exotic/Invasive**: *Sorbus aucuparia* (european mountain-ash, exotic)

CONSERVATION STATUS RANK

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

CLASSIFICATION

Status: Standard

Classification Confidence: 2 - Moderate

Global Comments: This type is either west of the range of *Fagus grandifolia* (American beech), or within the range of *Fagus* (beech) may occupy drier, and perhaps somewhat less acidic, sites (Chambers et al. 1997). In Michigan this type is found mostly on till/bedrock in western Upper Peninsula. Going eastward in the United States and Canada, the presence of *Picea rubens* (red spruce) may be a good indicator as to when *Tsuga canadensis - (Betula alleghaniensis) - Picea rubens / Cornus canadensis* Forest (CEGL006129) occurs. Other more eastern species include *Acer pensylvanicum* (striped maple), *Viburnum lantanoides* (hobblebush), and *Trillium undulatum* (painted trillium) (Rogers 1980). The data by Rogers (1980), who examined pure hemlock stands (many of them less than 2 ha in size) from Wisconsin to Nova Scotia, make clear that there are few species strictly associated with a pure hemlock versus a mixed hemlock-hardwood type, and also indicate that some distinction between a Great Lakes versus northeastern United States/eastern Canada has some merit.

Global Similar Associations:

- *Acer saccharum - Tilia americana / Ostrya virginiana / Lonicera canadensis* Forest (CEGL002458)
- *Tsuga canadensis - (Betula alleghaniensis) - Picea rubens / Cornus canadensis* Forest (CEGL006129)--is found in the northeastern United States and contains *Picea rubens*.
- *Tsuga canadensis - (Betula alleghaniensis)* Forest (CEGL002598)
- *Tsuga canadensis - Acer saccharum / (Hepatica nobilis* var. *acuta)* Driftless Forest (CEGL002597)
- *Tsuga canadensis - Fagus grandifolia - (Acer saccharum)* Great Lakes Forest (CEGL005042)--appears to be more mesic, is more eastward and contains beech.

Global Related Concepts:

- Acer-Tsuga/Dryopteris (Kotar et al. 1988) F
- Acer-Tsuga/Maianthemum (Kotar et al. 1988) F
- Mesic Northern Forest - Hemlock-Beech (Chapman et al. 1989) =
- Sugar Maple-Hemlock-Yellow Birch-Striped Maple (V16) (Chambers et al. 1997) =

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ELEMENT DISTRIBUTION

Apostle Islands National Lakeshore Range: This hemlock - hardwoods is found on Bear, Oak, Outer, Sand, and Stockton islands.
Global Range: This hemlock-hardwoods community type is found in the northern Great Lakes region of the United States and Canada, ranging from Michigan and Wisconsin to Ontario.
Nations: CA, US
States/Provinces: MI:S4, ON, WI:S3S4
TNC Ecoregions: 46:C, 47:C, 48:C
USFS Ecoregions (1994/95): 212Ha:CCC, 212Hb:CCC, 212He:CC?, 212Hi:CCC, 212Hm:CCP, 212Hp:CCP, 212Hq:CCP, 212Hs:CCP, 212Ht:CCP, 212Hw:CCP, 212Ia:CCC, 212Ja:CCP, 212Jb:CCC, 212Jc:CCC, 212Je:CC?, 212Jf:CCP, 212Jj:CCP, 212Jl:CCC, 212Jm:CCC, 212Jn:CCC, 212Jo:CCP, 212Jr:CCC, 212Js:CCC, 212Oa:CCC, 222Ja:CCC, 222Je:CCC, 222Jj:CCC, 222Ka:CCC
Federal Lands: NPS (Apostle Islands, Pictured Rocks); USFS (Chequamegon, Chequamegon-Nicolet, Hiawatha, Nicolet, Ottawa)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (13 plots): APIS.010, APIS.020, APIS.104, APIS.127, APIS.138, APIS.301, APIS.304, APIS.311, APIS.317, APIS.318, APIS.322, APIS.330, APIS.402.
Apostle Islands National Lakeshore Map Code: FHM
Local Description Authors: M.J. Russo
Global Description Authors: D. Faber-Langendoen
References: Chambers et al. 1997, Chapman et al. 1989, Curtis 1959, Frelich and Lorimer 1991a, Frelich and Lorimer 1991b, Frelich et al. 1993, Kotar et al. 1988, Midwestern Ecology Working Group n.d., Rogers 1980, Tyrrell and Crow 1994, WNHIP unpubl. data

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

Jack Pine - Northern Pin Oak Forest

***Pinus banksiana - (Pinus resinosa) - Quercus ellipsoidalis / Carex pensylvanica* Forest**
Jack Pine - (Red Pine) - Northern Pin Oak / Pennsylvania Sedge Forest
Identifier: CEGL002478

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)	Jack Pine - Northern Pin Oak Forest
Ecological System(s):	Laurentian Pine-Oak Barrens (CES201.718)

ELEMENT CONCEPT

Global Summary: This jack pine - oak forest community type is found near the western Great Lakes of the United States and Canada on well-drained, sandy, infertile soils. Sites are typically relatively flat and occur on outwash plains or glaciolacustrine beds. The overstory of this forest community has a moderately closed to closed canopy. Tree density can be very high (up to several hundred trees/ha). The dominant canopy species are *Pinus banksiana* (jack pine) and *Quercus ellipsoidalis* (northern pin oak). In some stands these two species constitute nearly the entire canopy. Where other trees are present, they typically include *Acer rubrum* (red maple), *Pinus resinosa* (red pine), and *Populus tremuloides* (quaking aspen). The shrub layer is sparse to well-defined. *Vaccinium angustifolium* (lowbush blueberry) is very common, but *Corylus cornuta* (beaked hazelnut), *Corylus americana* (American hazelnut), *Rosa* (rose) spp., and *Rubus* (blackberry) spp. are other common constituents. *Gaylussacia baccata* (black huckleberry) is common in central Michigan and Wisconsin. The herbaceous layer contains species such as *Carex pensylvanica* (Pennsylvania sedge), *Fragaria virginiana* (Virginia strawberry), *Lysimachia quadrifolia* (whorled yellow loosestrife), *Maianthemum canadense* (Canada mayflower), *Maianthemum racemosum* (feathery false lily of the valley), and *Pteridium aquilinum* (western brackenfern).

ENVIRONMENTAL DESCRIPTION

Global Environment: This community is found on well-drained, sandy, infertile soils (Curtis 1959). Sites are typically relatively flat and occur on outwash plains or glaciolacustrine beds (MNNHP 1993).

VEGETATION DESCRIPTION

Global Vegetation: *Vaccinium angustifolium* (lowbush blueberry) is very common, but *Corylus americana* (American hazelnut), *Corylus cornuta* (beaked hazelnut), *Rosa* (rose) spp., and *Rubus* (blackberry) spp. are other common constituents. *Gaylussacia baccata* (black huckleberry) is common in central Michigan and Wisconsin. The herbaceous layer contains species such as *Carex pensylvanica* (Pennsylvania sedge), *Fragaria virginiana* (Virginia strawberry), *Lysimachia quadrifolia* (whorled yellow loosestrife), *Maianthemum canadense* (Canada mayflower), *Maianthemum racemosum* (feathery false lily of the valley), and *Pteridium aquilinum* (western brackenfern) (Curtis 1959, MNNHP 1993).

CONSERVATION STATUS RANK

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

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CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Global Comments: *Pinus strobus* (eastern white pine), *Quercus rubra* (northern red oak), *Quercus macrocarpa* (bur oak) and *Quercus velutina* (black oak) may also occur in this type. The distinction between this type and *Pinus banksiana / (Quercus rubra, Quercus ellipsoidalis)* Forest (CEGL002440) is that the latter is primarily found on bedrock, with oaks occurring primarily as grubs and only rarely are in the canopy. This type also overlaps with *Pinus banksiana / Vaccinium* spp. / *Pleurozium schreberi* (Schreber's big red stem moss) Forest (CEGL002441), especially in Wisconsin, where timber management can cause a lot of variation in the proportion of oak and pine (E. Epstein pers. comm. 2000).
Global Similar Associations:
- *Pinus banksiana / (Quercus rubra, Quercus ellipsoidalis)* Forest (CEGL002440)--This is a dry, pure evergreen jack pine type with some oak in the understory, found most typically on bedrock.
- *Pinus banksiana / Vaccinium* spp. / *Pleurozium schreberi* Forest (CEGL002441)--This is the pure evergreen jack pine type.

Global Related Concepts:
- Dry Northern Forest - Red Pine-Jack Pine (Oak) (Chapman et al. 1989) B

ELEMENT DISTRIBUTION

Global Range: This community is found in northern Minnesota, northern and central Wisconsin, northern Michigan, and Ontario.
Nations: CA, US
States/Provinces: MI, MN, ON, WI
TNC Ecoregions: 46:C, 47:C, 48:C
USFS Ecoregions (1994/95): 212Hb:CCP, 212He:CCP, 212Hi:CCP, 212Hm:CCP, 212Hp:CCC, 212Hq:CCP, 212Hr:CCP, 212Hs:CCP, 212Ht:CCP, 212Hu:CCP, 212Hv:CCP, 212Hw:CCP, 212Hy:CCP, 212Ia:CCC, 212Ja:CPP, 212Jb:CP?, 212Jc:CPP, 212Jj:CPP, 212Jl:CPP, 212Jm:CPP, 212Jn:CPP, 212Jo:CPP, 212Jr:CPP, 212Ka:CPP, 212Na:CCP, 212Nb:CCP, 212Nc:CCC, 222Ka:CCC
Federal Lands: NPS (Apostle Islands, Saint Croix, Sleeping Bear Dunes, Voyageurs); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Huron, Huron-Manistee, Manistee, Nicolet, Ottawa)

ELEMENT SOURCES

Apostle Islands National Lakeshore Map Code: FJO
Local Description Authors:
Global Description Authors: J. Drake
References: Chapman et al. 1989, Curtis 1959, MNNHP 1993, Midwestern Ecology Working Group n.d., WNHIP unpubl. data

Red Pine - Aspen - Birch Forest

***Pinus resinosa - Populus tremuloides / Diervilla lonicera - Vaccinium* spp. Forest**
Red Pine - Quaking Aspen / Northern Bush-honeysuckle - Blueberry species Forest
Identifier: CEGL002520

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)	Red Pine - Aspen - Birch Forest
Ecological System(s):	Laurentian-Acadian Northern Pine-(Oak) Forest (CES201.719)

ELEMENT CONCEPT

Global Summary: This red pine - hardwood mixed forest is found in the boreal regions of the midwestern United States and in central and possibly eastern Canada. Stands are found on well-drained upland sites on a variety of landforms. Soils are coarse sandy and shallow to deep. Stands contain a mix of deciduous and evergreen trees, comprising mainly *Pinus resinosa* (red pine) as the conifer, with some *Pinus banksiana* (jack pine), *Pinus strobus* (eastern white pine), and *Abies balsamea* (balsam fir). Less frequent associates include *Picea glauca* (white spruce) and *Picea mariana* (black spruce). Hardwoods include *Betula papyrifera* (paper birch), *Populus grandidentata* (bigtooth aspen) and *Populus tremuloides* (quaking aspen). The shrub and herb layers vary from dense to open. Tall and dwarf-shrubs include *Abies balsamea* (balsam fir), *Acer spicatum* (mountain maple), *Amelanchier* (serviceberry) spp., *Corylus cornuta* (beaked hazelnut), *Diervilla lonicera* (northern bush honeysuckle), *Linnaea borealis* (twinflower), *Lonicera canadensis* (American fly honeysuckle), *Vaccinium angustifolium* (lowbush blueberry), and *Vaccinium myrtilloides* (velvetleaf huckleberry). Herbs include *Eurybia macrophylla* (bigleaf aster), *Aralia nudicaulis* (wild sarsaparilla), *Clintonia borealis* (bluebead), *Cornus canadensis* (bunchberry dogwood), and *Maianthemum canadense* (Canada mayflower). Large patches of feathermoss can develop on the forest floor. Moss species include *Dicranum polysetum* (dicranum moss) and *Pleurozium schreberi* (Schreber's big red stem moss).

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ENVIRONMENTAL DESCRIPTION

Apostle Islands National Lakeshore Environment: This red pine - hardwood mixed forest was sampled at four locations in the park: Long Island (1 site), Michigan Island (1), Oak Island (1), and Stockton Island (1). Sites occur on gentle to moderate midslopes and ridges with variable aspects. Soils are rapidly to well-drained sand. The unvegetated surface is dominated by leaf litter (75-100% cover) with some wood (0-25%). Evidence of disturbance includes wind damage (blowdowns) and past fire.
Global Environment: Stands are found on well-drained upland sites on a variety of landforms. Soils are coarse sandy, and shallow to deep (Sims et al. 1989, McCarthy et al. 1994).

VEGETATION DESCRIPTION

Apostle Islands National Lakeshore Vegetation: The moderate to dense (50-80% cover) tree canopy, 20-35 m tall, is dominated by *Pinus resinosa* (red pine) and may include *Acer rubrum* (red maple), *Pinus strobus* (eastern white pine), and/or *Quercus rubra* (northern red oak). The very sparse to moderate (5-40%) subcanopy (10-20 m) may include *Abies balsamea* (balsam fir) and *Quercus ellipsoidalis* (northern pin oak). The sparse (10-20%) tall-shrub layer (2-5 m) may contain *Abies balsamea* (balsam fir) and *Corylus cornuta* (beaked hazelnut), and the very sparse to moderate (5-40%) short-shrub layer (0.5-1 m) is dominated by *Gaylussacia baccata* (black huckleberry) and *Taxus canadensis* (Canada yew). *Vaccinium angustifolium* (lowbush blueberry) forms a very sparse (5%) dwarf-shrub layer (<0.5 m). Dominant species in the variable herbaceous layer (5-60%) include *Aralia nudicaulis* (wild sarsaparilla), *Maianthemum canadense* (Canada mayflower), and *Pteridium aquilinum* (western brackenfern). Nonvascular species (mosses), including *Pleurozium schreberi* (Schreber's big red stem moss), may cover 5-10% of the ground surface. In addition, state-vulnerable (S3) *Deschampsia flexuosa* (wavy hairgrass) was recorded in one of the sampled plots.
Global Vegetation: Stands contain a mix of deciduous and evergreen trees, comprising mainly *Pinus resinosa* (red pine) as the conifer, with some *Pinus banksiana* (jack pine), *Pinus strobus* (eastern white pine), and *Abies balsamea* (balsam fir). Less frequent associates include *Picea glauca* (white spruce) and *Picea mariana* (black spruce). Hardwoods include *Betula papyrifera* (paper birch), *Populus grandidentata* (bigtooth aspen) and *Populus tremuloides* (quaking aspen). The shrub and herb layer varies from dense to open. Tall and dwarf-shrubs include *Abies balsamea* (balsam fir), *Acer spicatum* (mountain maple), *Amelanchier* (serviceberry) spp., *Corylus cornuta* (beaked hazelnut), *Diervilla lonicera* (northern bush honeysuckle), *Linnaea borealis* (twinflower), *Lonicera canadensis* (American fly honeysuckle), *Vaccinium angustifolium* (lowbush blueberry), and *Vaccinium myrtilloides* (velvetleaf huckleberry). Herbs include *Eurybia macrophylla* (bigleaf aster), *Aralia nudicaulis* (wild sarsaparilla), *Clintonia borealis* (bluebead), *Cornus canadensis* (bunchberry dogwood), and *Maianthemum canadense* (Canada mayflower). Large patches of feathermoss can develop on the forest floor. Moss species include *Dicranum polysetum* (dicranum moss) and *Pleurozium schreberi* (Schreber's big red stem moss) (Sims et al. 1989, McCarthy et al. 1994).

MOST ABUNDANT SPECIES

Apostle Islands National Lakeshore

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus resinosa* (red pine)
Tree canopy	Broad-leaved deciduous tree	*Quercus rubra* (northern red oak)
Tree subcanopy	Broad-leaved deciduous tree	*Quercus ellipsoidalis* (northern pin oak)
Short shrub/sapling	Broad-leaved deciduous shrub	*Gaylussacia baccata* (black huckleberry)
Herb (field)	Fern or fern ally	*Pteridium aquilinum* (western brackenfern)

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Abies balsamea* (balsam fir), *Acer rubrum* (red maple), *Aralia nudicaulis* (wild sarsaparilla), *Corylus cornuta* (beaked hazelnut), *Gaylussacia baccata* (black huckleberry), *Maianthemum canadense* (Canada mayflower), *Pinus resinosa* (red pine), *Pteridium aquilinum* (western brackenfern), *Quercus ellipsoidalis* (northern pin oak), *Quercus rubra* (northern red oak), *Taxus canadensis* (Canada yew)

OTHER NOTEWORTHY SPECIES

Apostle Islands National Lakeshore: Vulnerable: *Deschampsia flexuosa* (wavy hairgrass, state-vulnerable, G5)

CONSERVATION STATUS RANK

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

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Global Comments: This type overlaps floristically with *Pinus resinosa / Vaccinium* spp. Forest (CEGL002443), the pure evergreen red pine forest, but is somewhat more diverse in the shrub and herb layers.
Global Similar Associations:
- *Pinus resinosa / Vaccinium* spp. Forest (CEGL002443)

Global Related Concepts:
- Red Pine Mixedwood (V13) (Sims et al. 1989) =
- Red Pine Mixedwood (V5) (McCarthy et al. 1994) =

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ELEMENT DISTRIBUTION

Apostle Islands National Lakeshore Range: This red pine - hardwood forest occurs on Long, Michigan, Oak, and Stockton islands.
Global Range: This red pine-hardwood mixed forest community type is found in the boreal regions of the midwestern United States and in central and possibly eastern Canada, ranging from Minnesota north and east to Manitoba, Ontario and possibly elsewhere in eastern Canada.
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, 212Ja:CCC, 212Kb:CCC, 212La:CCP, 212Lb:CCC, 212Ld:CCC
Federal Lands: NPS (Apostle Islands, Pictured Rocks, Saint Croix, Sleeping Bear Dunes, Voyageurs); USFS (Superior?)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (4 plots): APIS.009, APIS.025, APIS.116, APIS.227.
Apostle Islands National Lakeshore Map Code: FRA
Local Description Authors: M.J. Russo
Global Description Authors: D. Faber-Langendoen
References: Greenall 1996, McCarthy et al. 1994, Midwestern Ecology Working Group n.d., Sims et al. 1989

Red Pine / Blueberry Dry Forest

***Pinus resinosa / Vaccinium* spp. Forest**
Red Pine / Blueberry species Forest
Identifier: CEGL002443

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)	Red Pine / Blueberry Dry Forest
Ecological System(s):	Laurentian-Acadian Northern Pine-(Oak) Forest (CES201.719)

ELEMENT CONCEPT

Global Summary: This upland red pine community is found in the boreal regions of the midwestern United States and in central and possibly eastern Canada. This community occurs on Precambrian bedrock, overlaid with medium deep, coarse sand or coarse loam soils. Moisture varies from dry to dry-mesic, and stands are on mid to upper gentle slopes. Stands contain a pine overstory and a poorly developed understory. *Pinus resinosa* (red pine) is the dominant overstory species (generally >80% cover). *Pinus strobus* (eastern white pine) can be prominent in the canopy and is often numerous in the sapling and seedling classes. Other species include *Abies balsamea* (balsam fir), *Pinus banksiana* (jack pine), *Picea mariana* (black spruce), *Picea glauca* (white spruce), and *Populus tremuloides* (quaking aspen). Northern hardwoods, such as *Acer rubrum* (red maple) and *Betula papyrifera* (paper birch), sometimes form a subcanopy. The understory ranges from moderately herb- and shrub-rich to extremely poor. In the tall-shrub strata, the important species are *Amelanchier* (serviceberry) spp. and *Corylus cornuta* (beaked hazelnut). The short-shrub layer includes *Linnaea borealis* (twinflower), *Gaultheria procumbens* (eastern teaberry), *Vaccinium angustifolium* (lowbush blueberry), and *Vaccinium myrtilloides* (velvetleaf huckleberry), particularly where gaps in the canopy occur. The herb layer is very poorly represented in most parts of this community's range and includes *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Cornus canadensis* (bunchberry dogwood), *Maianthemum canadense* (Canada mayflower), *Pteridium aquilinum* (western brackenfern), and *Trientalis borealis* (starflower). Mosses are abundant, especially *Dicranum* (dicranum moss) spp. (including *Dicranum polysetum* (dicranum moss)) and *Pleurozium schreberi* (Schreber's big red stem moss). Diagnostic features include the dominance of *Pinus resinosa* (red pine) and the ericaceous understory.

ENVIRONMENTAL DESCRIPTION

Global Environment: This community occurs on Precambrian bedrock, overlaid with medium deep (>60 cm), coarse sand or coarse loam soils. Moisture varies from dry to dry-mesic, and stands are on mid to upper gentle slopes. The climate is highly variable, with temperature extremes between -46 and 38 degrees C, and with anywhere from 58-91 cm of precipitation.

VEGETATION DESCRIPTION

Global Vegetation: This community is characterized by a pine overstory and a poorly developed understory. *Pinus resinosa* (red pine) is present in the canopy at higher cover and basal area than other conifers (typically 80% or more). *Pinus strobus* (eastern white pine) can be common in the canopy. Mesic sites tend to include not only *Pinus resinosa* (red pine) in the canopy, but also *Picea mariana* (black spruce), *Picea glauca* (white spruce), and *Abies balsamea* (balsam fir), whereas on dry sites, *Pinus banksiana* (jack pine) is found (MNNHP 1993). Beneath the canopy, northern hardwoods, such as *Acer rubrum* (red maple) and *Betula papyrifera* (paper birch), sometimes form a subcanopy. The understory ranges from moderately herb- and shrub-rich to extremely poor. In the tall shrub class, the important species are *Amelanchier* (serviceberry) spp. and *Corylus cornuta* (beaked hazelnut). The short-shrub layer includes *Gaultheria procumbens* (eastern teaberry), *Linnaea borealis* (twinflower), *Vaccinium angustifolium* (lowbush blueberry), and *Vaccinium myrtilloides* (velvetleaf huckleberry), particularly where gaps in the canopy occur (Ohmann and Ream 1971). The herb

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layer is very poorly represented in most parts of this community's range and includes *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Cornus canadensis* (bunchberry dogwood), *Maianthemum canadense* (Canada mayflower), *Pteridium aquilinum* (western brackenfern), and *Trientalis borealis* (starflower). Mosses can have very high cover and typically include *Dicranum* (dicranum moss) spp. (including *Dicranum polysetum* (dicranum moss)) and *Pleurozium schreberi* (Schreber's big red stem moss). The average coverage of feathermoss is greater in the northwest region of Ontario than in the north-central region (Sims et al. 1989).

MOST ABUNDANT SPECIES

Global

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus resinosa* (red pine)
Tall shrub/sapling	Broad-leaved evergreen tree	*Corylus cornuta* (beaked hazelnut)
Short shrub/sapling	Broad-leaved deciduous shrub	*Vaccinium angustifolium* (lowbush blueberry), *Vaccinium myrtilloides* (velvetleaf huckleberry)
Nonvascular	Moss	*Pleurozium schreberi* (Schreber's big red stem moss)

CHARACTERISTIC SPECIES

Global: *Corylus cornuta* (beaked hazelnut), *Pinus resinosa* (red pine), *Vaccinium angustifolium* (lowbush blueberry), *Vaccinium myrtilloides* (velvetleaf huckleberry)

CONSERVATION STATUS RANK

Global Rank & Reasons: G3 (6-Feb-2007). There are probably over 100 occurrences of this community rangewide. Currently there are 77 occurrences documented from Michigan (where it is ranked S3), Minnesota (S3), and Wisconsin (S3); it is also reported from Manitoba (S3) and Ontario (S?). There are probably over 10,000 acres of this community rangewide. Currently 5545 acres have been documented from 45 occurrences in Michigan, Minnesota, and Wisconsin. Many sites have been degraded by logging, but there are also many mature to old-growth stands remaining.

CLASSIFICATION

Status: Standard

Classification Confidence: 1 - Strong

Global Comments: Stands are dominated by *Pinus resinosa* (red pine), with at least 60% cover, and typically 80% or more. Stands can intergrade with white pine, and these mixed stands are placed with the white pine types, either White Pine-Mountain Maple Mesic Forest, *Pinus strobus / Acer spicatum - Corylus cornuta* Forest (CEGL002445), or White Pine/Blueberry Dry-mesic Forest, *Pinus strobus / Vaccinium* spp. Forest (CEGL002444). Red pine stands in the central Great Lakes region, often on sandy outwash, are treated with more boreal stands as one type, since the ericaceous component is similar. It remains to be seen whether the central stands lack enough of the more common boreal elements of the northern stands to warrant a separate type.

A survey of vegetation of the dunes of Lake Michigan in Manistee National Forest in Michigan (Hazlett 1986) found a community very similar to *Pinus resinosa / Vaccinium* spp. Forest. This pine forest would appear to belong with the Great Lakes Dune Pine Forest, *Pinus banksiana - Pinus resinosa - Pinus strobus* Dune Forest (CEGL002589). The described community was closely associated with bogs within the lake dunes. The forest canopy was dominated by *Pinus resinosa* (red pine) (75-100% cover), although on the drier ridges inclusions of *Quercus velutina* (black oak) and *Populus grandidentata* (bigtooth aspen) were common. Other trees that were found in the canopy included *Acer rubrum* (red maple), *Betula papyrifera* (paper birch), *Quercus alba* (white oak), and *Quercus rubra* (northern red oak). In the understory, species that were found in this community subtype, but not in the main community type, included *Gaylussacia baccata* (black huckleberry), *Hamamelis virginiana* (American witch-hazel), and *Viburnum nudum* var. *cassinoides* (withe-rod). Many species of herbs were present, but no feathermosses were listed.

Global Similar Associations:

- *Pinus banksiana - (Pinus resinosa) / Corylus cornuta* Forest (CEGL002442)
- *Pinus banksiana - (Quercus ellipsoidalis) / Schizachyrium scoparium* - Prairie Forbs Wooded Herbaceous Vegetation (CEGL002490)
- *Pinus banksiana - Pinus resinosa - (Quercus ellipsoidalis) / Carex pensylvanica* Wooded Herbaceous Vegetation (CEGL005124)
- *Pinus banksiana - Pinus resinosa - Pinus strobus* Dune Forest (CEGL002589)
- *Pinus resinosa - Populus tremuloides / Diervilla lonicera - Vaccinium* spp. Forest (CEGL002520)--is dominated by red pine and aspen and/or birch.
- *Pinus strobus - Populus tremuloides / Corylus cornuta* Forest (CEGL002479)--is dominated by white pine and aspen.
- *Pinus strobus / Acer spicatum - Corylus cornuta* Forest (CEGL002445)
- *Pinus strobus / Vaccinium* spp. Forest (CEGL002444)--pure white pine type on drier sites with blueberry/feathermoss understory that resembles red pine stands.

Global Related Concepts:

- Dry Northern Forest - Red Pine-Jack Pine (Oak) (Chapman et al. 1989) B
- Red Pine (Ohmann and Ream 1971) =
- Red Pine Conifer (V27) (Sims et al. 1989) ?

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- Red Pine-White Pine-Jack Pine-Blueberry-Feathermoss (V30) (Chambers et al. 1997) F
- Red Pine-White Pine-Jack Pine-Largetooth Aspen-White Pine Shrub-Wintergreen (V31) (Chambers et al. 1997) F

ELEMENT DISTRIBUTION

Global Range: This upland red pine community type is found in the boreal regions of the midwestern United States and in central and possibly eastern Canada, ranging from Minnesota and southwestern Manitoba east to Michigan, Ontario, and possibly further east.
Nations: CA, US
States/Provinces: MB:S1, MI, MN:S3, ON, QC:S3?, WI:S3
TNC Ecoregions: 46:C, 47:C, 48:C
USFS Ecoregions (1994/95): 212Ha:CCC, 212Hb:CCP, 212He:CC?, 212Hh:CCC, 212Hi:CCP, 212Hj:CCC, 212Hk:CC?, 212Hl:CCC, 212Hm:CCP, 212Ho:CCC, 212Hp:CCP, 212Hq:CCC, 212Hr:CCP, 212Hs:CCP, 212Ht:CCP, 212Hu:CCP, 212Hv:CCP, 212Hw:CCC, 212Hx:CCP, 212Hy:CCP, 212Ia:CCC, 212Ja:CCC, 212Jb:CCP, 212Jc:CCC, 212Jf:CCP, 212Jj:CCP, 212Jl:CCC, 212Jm:CCC, 212Jn:CCP, 212Jo:CC?, 212Ka:CCC, 212Kb:CCC, 212La:CCC, 212Lb:CCP, 212Lc:CCC, 212Mb:CCC, 212Na:CCC, 212Nb:CCC, 212Nc:CCC, 222Mc:CCC
Federal Lands: NPS (Apostle Islands, Pictured Rocks, Saint Croix, Sleeping Bear Dunes, Voyageurs); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Hiawatha, Huron, Huron-Manistee, Manistee, Nicolet, Ottawa, Superior)

ELEMENT SOURCES

Apostle Islands National Lakeshore Map Code: FRP
Local Description Authors:
Global Description Authors: A. Szostak, mod. D. Faber-Langendoen 04-00
References: Ahlgren 1974, Chambers et al. 1997, Chapman et al. 1989, Farrand and Bell 1982, Frelich 1992, Greenall 1996, Grigal and Ohmann 1975, Hazlett 1986, Heinselman 1973, MNNHP 1993, Midwestern Ecology Working Group n.d., Ohmann and Ream 1971, Sims et al. 1989, WNHIP unpubl. data

White Pine - Aspen - Birch Forest

***Pinus strobus - Populus tremuloides / Corylus cornuta* Forest**
Eastern White Pine - Quaking Aspen / Beaked Hazelnut Forest
Identifier: CEGL002479

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 - Aspen - Birch Forest
Ecological System(s):	Laurentian-Acadian Northern Pine-(Oak) Forest (CES201.719)

ELEMENT CONCEPT

Global Summary: This white pine - hardwood forest is found in the Great Lakes region of the United States and Canada. Stands are found on a variety of slope positions on deep (>60 cm), dry-mesic to mesic, rapidly drained soils, with fine sandy to loamy soil textures. The tree canopy is mixed evergreen-deciduous. *Pinus strobus* (eastern white pine) may form a supercanopy over a mixture of other species, including *Betula papyrifera* (paper birch), *Populus tremuloides* (quaking aspen), *Picea glauca* (white spruce), and *Abies balsamea* (balsam fir). Less frequent are *Pinus resinosa* (red pine), *Populus grandidentata* (bigtooth aspen), and *Thuja occidentalis* (northern white-cedar). The subcanopy can include *Acer rubrum* (red maple) and *Acer saccharum* (sugar maple), as well as a mixture of canopy species. Tall shrubs and saplings include *Abies balsamea* (balsam fir), *Acer spicatum* (mountain maple), *Amelanchier* (serviceberry) spp. and *Corylus cornuta* (beaked hazelnut). Short shrubs include *Diervilla lonicera* (northern bush honeysuckle), *Linnaea borealis* (twinflower), *Lonicera canadensis* (American fly honeysuckle), and *Vaccinium myrtilloides* (velvetleaf huckleberry). *Viburnum nudum* var. *cassinoides* (withe-rod) may be present in the eastern part of the range. Herbs include *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Clintonia borealis* (bluebead), *Cornus canadensis* (bunchberry dogwood), *Maianthemum canadense* (Canada mayflower), *Oryzopsis asperifolia* (roughleaf ricegrass), *Pteridium aquilinum* (western brackenfern), *Streptopus lanceolatus* var. *longipes* (twistedstalk), and *Trientalis borealis* (starflower). Typical mosses include *Pleurozium schreberi* (Schreber's big red stem moss), *Dicranum polysetum* (dicranum moss) and *Dicranum flagellare* (dicranum moss).

ENVIRONMENTAL DESCRIPTION

Apostle Islands National Lakeshore Environment: This white pine - hardwood forest was sampled twice on Long Island. One site is a gently sloping ridge with well-drained sand soil, the other a gently sloping depression with moderately well-drained sand soil. The unvegetated surface is dominated by leaf litter (70-75% cover) with some wood (10-20%) and bare soil (0-10%). Evidence of disturbance includes deer browse and windthrown trees.
Global Environment: Stands are found on a variety of slope positions on deep (>60 cm), dry-mesic to mesic, rapidly drained soils, with fine sandy to loamy soil textures (Sims et al. 1989, MNNHP 1993, Chambers et al. 1997).

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VEGETATION DESCRIPTION

Apostle Islands National Lakeshore Vegetation: The moderate (60-70% cover) tree canopy, 15-35 m tall, is dominated by *Pinus strobus* (eastern white pine) and/or *Quercus ellipsoidalis* (northern pin oak); additional species may include *Acer rubrum* (red maple) and *Pinus banksiana* (jack pine). The very sparse (10-30%) tall-shrub layer (2-5 m) may instead be dominated by *Pinus strobus* (eastern white pine), as in one of the sampled plots. The sparse (30-40%) short-shrub layer (0.5-1 m) is dominated by *Gaylussacia baccata* (black huckleberry) and *Juniperus communis* (common juniper). *Vaccinium angustifolium* (lowbush blueberry) forms a very sparse (10%) dwarf-shrub layer. The very sparse (<5-10%) herbaceous layer includes small amounts of *Cornus canadensis* (bunchberry dogwood), *Deschampsia flexuosa* (wavy hairgrass) (state-vulnerable), *Dryopteris carthusiana* (spinulose woodfern), *Gaultheria procumbens* (eastern teaberry), *Lycopodium* (clubmoss) spp., *Maianthemum canadense* (Canada mayflower), *Melampyrum lineare* (narrowleaf cowwheat), *Pteridium aquilinum* (western brackenfern), and *Trientalis borealis* (starflower).
Global Vegetation: The tree canopy is mixed evergreen-deciduous. *Pinus strobus* (eastern white pine) may form a supercanopy over a mixture of other species, including *Betula papyrifera* (paper birch), *Populus tremuloides* (quaking aspen), *Picea glauca* (white spruce), and *Abies balsamea* (balsam fir). Less frequent are *Pinus resinosa* (red pine), *Populus grandidentata* (bigtooth aspen), and *Thuja occidentalis* (northern white-cedar). The subcanopy can include *Acer rubrum* (red maple) and *Acer saccharum* (sugar maple), as well as a mixture of canopy species. Tall shrubs and saplings include *Abies balsamea* (balsam fir), *Acer spicatum* (mountain maple), *Amelanchier* (serviceberry) spp., and *Corylus cornuta* (beaked hazelnut). Short shrubs include *Diervilla lonicera* (northern bush honeysuckle), *Linnaea borealis* (twinflower), *Lonicera canadensis* (American fly honeysuckle), and *Vaccinium myrtilloides* (velvetleaf huckleberry). *Viburnum nudum* var. *cassinoides* (withe-rod) may be present in the eastern part of the range. Herbs include *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Clintonia borealis* (bluebead), *Cornus canadensis* (bunchberry dogwood), *Maianthemum canadense* (Canada mayflower), *Oryzopsis asperifolia* (roughleaf ricegrass), *Pteridium aquilinum* (western brackenfern), *Streptopus lanceolatus* (twistedstalk), and *Trientalis borealis* (starflower). Typical mosses include *Pleurozium schreberi* (Schreber's big red stem moss), *Dicranum polysetum* (dicranum moss) and *Dicranum flagellare* (dicranum moss) (Sims et al. 1989, MNNHP 1993, Chambers et al. 1997).

MOST ABUNDANT SPECIES

Apostle Islands National Lakeshore

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus strobus* (eastern white pine)
Tree canopy	Broad-leaved deciduous tree	*Quercus ellipsoidalis* (northern pin oak)
Tall shrub/sapling	Needle-leaved shrub	*Pinus strobus* (eastern white pine)
Short shrub/sapling	Needle-leaved shrub	*Juniperus communis* (common juniper)
Short shrub/sapling	Broad-leaved deciduous shrub	*Gaylussacia baccata* (black huckleberry)
Herb (field)	Dwarf-shrub	*Vaccinium angustifolium* (lowbush blueberry)

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Deschampsia flexuosa* (wavy hairgrass), *Gaultheria procumbens* (eastern teaberry), *Gaylussacia baccata* (black huckleberry), *Juniperus communis* (common juniper), *Pinus strobus* (eastern white pine), *Pteridium aquilinum* (western brackenfern), *Quercus ellipsoidalis* (northern pin oak), *Vaccinium angustifolium* (lowbush blueberry)

OTHER NOTEWORTHY SPECIES

Apostle Islands National Lakeshore: Vulnerable: *Deschampsia flexuosa* (wavy hairgrass, state-vulnerable, G5)

CONSERVATION STATUS RANK

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

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Global Comments: In Wisconsin and Michigan this type can originate as a result of forestry management and natural examples may be rare. In Wisconsin, this type did apparently occur prior to European settlement, but was more variable than what is described here (E. Epstein pers. comm. 1999). An aspen-birch-white pine type has also been recognized by Grigal and Ohmann (1975) [see also Heinselman (1996)], which consists of two subtypes, stands currently with a white pine overstory, and stands formerly with white pine but currently dominated by aspen-birch because of past logging and fire. Thus this type may be a relatively trivial split between pure evergreen white pine forest and pure deciduous aspen-birch types.
Global Similar Associations:
- *Picea glauca - Abies balsamea / Acer spicatum / Rubus pubescens* Forest (CEGL002446)
- *Pinus resinosa / Vaccinium* spp. Forest (CEGL002443)
- *Pinus strobus - (Pinus resinosa) - Quercus rubra* Forest (CEGL002480)
- *Pinus strobus / Acer spicatum - Corylus cornuta* Forest (CEGL002445)--This is essentially the mainly evergreen equivalent.
- *Populus tremuloides - Betula papyrifera - (Acer rubrum, Populus grandidentata)* Forest (CEGL002467)

Global Related Concepts:
- Dry-Mesic Northern Forest - Red Pine-White Pine (Chapman et al. 1989) B
- White Birch-White Pine-Trembling Aspen-Beaked Hazel-Mountain Maple (V23) (Chambers et al. 1997) =

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- White Pine Mixedwood (Sims et al. 1989) =

ELEMENT DISTRIBUTION

Apostle Islands National Lakeshore Range: This white pine - hardwood forest is found on Long Island.
Global Range: This white pine - hardwood forest community type is found in the Great Lakes region of the United States and Canada.
Nations: CA, US
States/Provinces: MI, MN:S3, ON, QC, WI:S4S5
TNC Ecoregions: 47:C, 48:C
USFS Ecoregions (1994/95): 212Ha:CCP, 212Hb:CCP, 212He:CCP, 212Hh:CCP, 212Hi:CCC, 212Hj:CCP, 212Hk:CCP, 212Hl:CCP, 212Hm:CCP, 212Hn:CCP, 212Ho:CCC, 212Hp:CCP, 212Hq:CCP, 212Hr:CCC, 212Hs:CCP, 212Ht:CCP, 212Hu:CCP, 212Hv:CCP, 212Hw:CCC, 212Hx:CC?, 212Hy:CCP, 212Ia:CCC, 212Ja:CPP, 212Jb:CPP, 212Jc:CPP, 212Jk:CPP, 212Jl:CPP, 212Jn:CPP, 212Jo:CPP, 212Jr:CPP, 212La:CCC, 212Lb:CCC, 212Lc:CCP, 212Ld:CCP, 212Mb:CPP, 212Na:CPP, 212Nb:CPP, 212Nc:CPP
Federal Lands: NPS (Apostle Islands, Grand Portage, Isle Royale, Pictured Rocks, Saint Croix, Sleeping Bear Dunes, Voyageurs); USFS (Chippewa, Huron, Huron-Manistee, Manistee?, Ottawa, Superior?)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (2 plots): APIS.229, APIS.230.
Apostle Islands National Lakeshore Map Code: FWA
Local Description Authors: M.J. Russo
Global Description Authors: D. Faber-Langendoen
References: Chambers et al. 1997, Chapman et al. 1989, Grigal and Ohmann 1975, Heinselman 1996, MNNHP 1993, Midwestern Ecology Working Group n.d., Sims et al. 1989, WNHIP unpubl. data

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
Ecological System(s):	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

Apostle Islands National Lakeshore Environment: This white pine forest was sampled three times in the park: twice near Little Sand Bay on the mainland and once on Bear Island. The mainland sites are on gentle to moderately sloping beach ridges; the Bear Island site is on a gentle northeast-facing lake terrace described as a "cuspate foreland" by Judziewicz (1993). Elevations range from 140 to 186 m (459-610 feet). Soils are rapidly to well-drained loamy sand and sand. The unvegetated surface is made up almost entirely of leaf litter (85-95% cover) with some wood (3-5%) and bare sand (0-15%). Evidence of disturbance includes past fire and heavy deer browse.

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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

Apostle Islands National Lakeshore Vegetation: The moderate (40-50% cover), tree canopy, 20-35 m tall, is dominated by *Betula papyrifera* (paper birch), *Pinus resinosa* (red pine), and *Pinus strobus* (eastern white pine), the sparse to moderate (30-50%) subcanopy (5-20 m) by *Abies balsamea* (balsam fir), *Acer rubrum* (red maple), and *Betula papyrifera* (paper birch) The sparse to moderate (20-60%) tall-shrub layer (2-5 m) is made up of subcanopy species and may include *Acer saccharum* (sugar maple). The sparse (5-30%) short-shrub layer (0.5-1 m) is dominated by *Diervilla lonicera* (northern bush honeysuckle) and may include lesser amounts of *Ledum groenlandicum* (bog Labrador-tea), *Sorbus decora* (northern mountain-ash), *Taxus canadensis* (Canada yew), and *Vaccinium myrtilloides* (velvetleaf huckleberry). *Vaccinium angustifolium* (lowbush blueberry) forms a moderate (50%) dwarf-shrub layer (<0.5 m) when present. The variable herbaceous layer (10-60%) is dominated by tree seedlings and *Gaultheria procumbens* (eastern teaberry); other common species include *Clintonia borealis* (bluebead), *Cornus canadensis* (bunchberry dogwood), *Eurybia macrophylla* (bigleaf aster), *Maianthemum canadense* (Canada mayflower), *Melampyrum lineare* (narrowleaf cowwheat), and *Trientalis borealis* (starflower). *Pteridium aquilinum* (western brackenfern) is a common fern. State-vulnerable (S3) *Deschampsia flexuosa* (wavy hairgrass) was recorded in two of the sampled plots. Nonvascular species (mosses and lichens) cover 5% 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* (twinflower), *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

Apostle Islands National Lakeshore

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus resinosa* (red pine), *Pinus strobus* (eastern white pine)
Tree canopy	Broad-leaved deciduous tree	*Betula papyrifera* (paper birch)
Tree subcanopy	Needle-leaved tree	*Abies balsamea* (balsam fir)
Tall shrub/sapling	Needle-leaved shrub	*Abies balsamea* (balsam fir)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Acer saccharum* (sugar maple)
Short shrub/sapling	Broad-leaved deciduous shrub	*Diervilla lonicera* (northern bush honeysuckle)
Herb (field)	Dwarf-shrub	*Gaultheria procumbens* (eastern teaberry)

Global

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

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Abies balsamea* (balsam fir), *Acer rubrum* (red maple), *Acer saccharum* (sugar maple), *Betula papyrifera* (paper birch), *Carex stricta* (upright sedge), *Deschampsia flexuosa* (wavy hairgrass), *Diervilla lonicera* (northern bush honeysuckle), *Gaultheria procumbens* (eastern teaberry), *Pinus resinosa* (red pine), *Pinus strobus* (eastern white pine), *Pteridium aquilinum* (western brackenfern), *Vaccinium angustifolium* (lowbush blueberry), *Vaccinium myrtilloides* (velvetleaf huckleberry)
Global: *Abies balsamea* (balsam fir), *Diervilla lonicera* (northern bush honeysuckle), *Eurybia macrophylla* (bigleaf aster), *Pinus strobus* (eastern white pine)

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OTHER NOTEWORTHY SPECIES

Apostle Islands National Lakeshore: Vulnerable: *Deschampsia flexuosa* (wavy hairgrass, state-vulnerable, G5); **Exotic/Invasive**: *Phleum pratense* (timothy, exotic, Medium)

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

Apostle Islands National Lakeshore Range: This white pine forest occurs near Little Sand Bay on the mainland and on Bear Island.
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)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (3 plots): APIS.036, APIS.100, APIS.140.
Apostle Islands National Lakeshore Map Code: FWM
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

White Pine / Blueberry Dry-Mesic Forest

***Pinus strobus / Vaccinium* spp. Forest**
Eastern White Pine / Blueberry species Forest
Identifier: CEGL002444

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 / Blueberry Dry-Mesic Forest

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Ecological System(s): Laurentian-Acadian Northern Pine-(Oak) Forest (CES201.719)

ELEMENT CONCEPT

Global Summary: This dry white pine forest community is found near the western Great Lakes region of the United States and Canada and eastward into the northeastern United States and eastern Canada. Stands occur on sandy soils within glaciated landscapes, such as moraines and till. It may be on flat to moderately sloping topography. Conifers dominate the overstory. *Pinus strobus* (eastern white pine) is the most abundant mature tree species, often found with small to substantial amounts of *Pinus resinosa* (red pine). Scattered *Acer rubrum* (red maple), *Betula papyrifera* (paper birch), and *Populus tremuloides* (quaking aspen) can be found as subcanopy or small canopy trees. The understory contains species such as *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Maianthemum canadense* (Canada mayflower), *Pteridium aquilinum* (western brackenfern), *Vaccinium angustifolium* (lowbush blueberry), and *Vaccinium myrtilloides* (velvetleaf huckleberry). An inland dune ridge variant occurs in Michigan; the overstory contains *Pinus strobus* (eastern white pine) and *Pinus resinosa* (red pine), the shrub layers contain *Vaccinium angustifolium* (lowbush blueberry) and *Arctostaphylos uva-ursi* (kinnikinnick), and *Pteridium aquilinum* (western brackenfern) is common in the understory.

ENVIRONMENTAL DESCRIPTION

Apostle Islands National Lakeshore Environment: This dry white pine forest was sampled at two locations in the park on the western end of Outer Island and on Stockton Island. The sites are flat to gently sloping with rapidly drained sand and well-drained loamy sand, respectively. The ground surface is made up of leaf litter (24-94% cover) with some wood (0-1%), bare sand (0-25%), dead plant stems (5%), and lichens (0-45%). Evidence of disturbance includes past fire.

Global Environment: This community is found on sandy soils. It occurs most often on glaciated landscapes, such as moraines and till, where sandy pockets occur, and may be on flat to moderately sloping topography (MNNHP 1993). It is also found on somewhat poorly drained sand and clay lakeplains. The inland dune variant occurs on dune ridges.

VEGETATION DESCRIPTION

Apostle Islands National Lakeshore Vegetation: The sparse to moderate (20-50% cover) tree canopy, 15-35 m tall, is dominated by *Pinus strobus* (eastern white pine) and may include lesser amounts of *Picea mariana* (black spruce) and *Pinus resinosa* (red pine). The sparse (20-30%) subcanopy (10-20 m) may include *Acer rubrum* (red maple), *Betula papyrifera* (paper birch), and *Populus grandidentata* (bigtooth aspen). The sparse (5-20%) tall-shrub layer (2-5 m) is also made up of saplings of the tree species. The sparse (0-20%) short-shrub layer (0.5-1 m) may include *Juniperus communis* (common juniper) and *Rosa acicularis* (prickly rose). *Arctostaphylos uva-ursi* (kinnikinnick), *Hudsonia tomentosa* (woolly beach-heather), *Prunus pumila* (sandcherry), *Vaccinium angustifolium* (lowbush blueberry), and *Vaccinium myrtilloides* (velvetleaf huckleberry) form a sparse (5-20%) dwarf-shrub layer (<0.5 m). The sparse to moderate herbaceous layer (30-50%) includes *Clintonia borealis* (bluebead), *Comandra umbellata* (bastard toadflax), *Deschampsia flexuosa* (wavy hairgrass) (state-vulnerable), *Gaultheria procumbens* (eastern teaberry), *Linnaea borealis* (twinflower), *Maianthemum canadense* (Canada mayflower), *Melampyrum lineare* (narrowleaf cowwheat), *Pteridium aquilinum* (western brackenfern), and *Trientalis borealis* (starflower). *Dryopteris carthusiana* (spinulose woodfern) and *Pteridium aquilinum* (western brackenfern) are common ferns. State-vulnerable (S3) *Deschampsia flexuosa* (wavy hairgrass) was recorded in all three sampled plots. Nonvascular species (mosses and lichens), including *Pleurozium schreberi* (Schreber's big red stem moss), cover 20-60% of the ground surface.

Global Vegetation: Conifers dominate the overstory. *Pinus strobus* (eastern white pine) is the most abundant mature tree species, often found with small to substantial amounts of *Pinus resinosa* (red pine). Scattered *Acer rubrum* (red maple), *Betula papyrifera* (paper birch), and *Populus tremuloides* (quaking aspen) can be found as subcanopy or small canopy trees. The understory contains species such as *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Maianthemum canadense* (Canada mayflower), *Pteridium aquilinum* (western brackenfern), and *Vaccinium* (blueberry) spp. (MNNHP 1993). An inland dune ridge variant occurs in Michigan; the overstory contains *Pinus strobus* (eastern white pine) and *Pinus resinosa* (red pine), the shrub layers contain *Vaccinium angustifolium* (lowbush blueberry) and *Arctostaphylos uva-ursi* (kinnikinnick), and *Pteridium aquilinum* (western brackenfern) is common in the understory (P. Comer pers. comm. 1996, D. Albert pers. comm. 1996).

MOST ABUNDANT SPECIES

Apostle Islands National Lakeshore

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus strobus* (eastern white pine)

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Abies balsamea* (balsam fir), *Arctostaphylos uva-ursi* (kinnikinnick), *Betula papyrifera* (paper birch), *Deschampsia flexuosa* (wavy hairgrass), *Hudsonia tomentosa* (woolly beach-heather), *Juniperus communis* (common juniper), *Maianthemum canadense* (Canada mayflower), *Pinus strobus* (eastern white pine), *Pleurozium schreberi* (Schreber's big red stem moss), *Populus grandidentata* (bigtooth aspen), *Pteridium aquilinum* (western brackenfern), *Vaccinium angustifolium* (lowbush blueberry), *Vaccinium myrtilloides* (velvetleaf huckleberry)

OTHER NOTEWORTHY SPECIES

Apostle Islands National Lakeshore: Vulnerable: *Deschampsia flexuosa* (wavy hairgrass, state-vulnerable, G5)

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CONSERVATION STATUS RANK

Global Rank & Reasons: G3G4 (22-Jun-1998). There are well over 100 occurrences rangewide, but the occurrences tend to be fairly small stands (under 100 acres) because of the somewhat restricted environmental requirements. Few old-growth remnants remain, but several are protected. This community may be dependent on occasional catastrophic fires (with a very long fire-return interval) to allow regeneration of pines instead of gradual succession to other forest types. Fire suppression, grazing, and logging in the last 100 years have substantially reduced the acreage of this forest type.

CLASSIFICATION

Status: Standard
Classification Confidence: 1 - Strong
Global Comments: This type is similar to *Pinus resinosa / Vaccinium* spp. Forest (CEGL002443). It occurs on droughty soils, influenced by adjacent moraines. The inland dune variant, found in Saginaw Bay and in Luce County (Two-hearted River), Upper Peninsula, could also be treated as a variant of the Great Lakes Dune Pine Forest, *Pinus banksiana - Pinus resinosa - Pinus strobus* Dune Forest (CEGL002589).
Global Similar Associations:
- *Pinus banksiana - (Quercus ellipsoidalis) / Schizachyrium scoparium* - Prairie Forbs Wooded Herbaceous Vegetation (CEGL002490)
- *Pinus banksiana - Pinus resinosa - Pinus strobus* Dune Forest (CEGL002589)--This is a pine forest on Great Lakes dunes.
- *Pinus resinosa / Vaccinium* spp. Forest (CEGL002443)
- *Pinus strobus / Acer spicatum - Corylus cornuta* Forest (CEGL002445)

Global Related Concepts:
- Dry-Mesic Northern Forest - Red Pine-White Pine (Chapman et al. 1989) B
- Northern Dry Forest (Curtis 1959) B
- SNE Dry oak/pine forest on sandy / gravelly soils (Rawinski 1984) B

ELEMENT DISTRIBUTION

Apostle Islands National Lakeshore Range: This dry white pine forest occurs on Outer Island and Stockton Island.
Global Range: This dry white pine forest community is found in the western Great Lakes region of the United States and Canada. It ranges from northern Minnesota and northwestern Ontario east possibly into Quebec. Its range extent is close to 200,000 square km.
Nations: CA, US
States/Provinces: MI, MN:S2, ON, QC, WI:S3
TNC Ecoregions: 46:C, 47:C, 48:C
USFS Ecoregions (1994/95): 212Hb:CCP, 212He:CCP, 212Hh:CCC, 212Hi:CCC, 212Hj:CCC, 212Hl:CCC, 212Hm:CCC, 212Ho:CCC, 212Hp:CCC, 212Hq:CCP, 212Hr:CCC, 212Hs:CCP, 212Ht:CCP, 212Hu:CCP, 212Hv:CCP, 212Hw:CCP, 212Hy:CCP, 212Ia:CCC, 212Ja:CCP, 212Jb:CCP, 212Jc:CCP, 212Jl:CCP, 212Jm:CCP, 212Jn:CCP, 212Jr:CCC, 212Ka:CCP, 212Kb:CCC, 212Na:CCC, 212Nb:CCP, 212Nc:CCC, 222Ma:CCC, 222Mc:CCC, M212:P
Federal Lands: NPS (Apostle Islands, Pictured Rocks, Sleeping Bear Dunes); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Huron, Huron-Manistee, Manistee?, Nicolet, Ottawa)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (2 plots): APIS.328, APIS.703.
Apostle Islands National Lakeshore Map Code: FWP
Local Description Authors: M.J. Russo
Global Description Authors: J. Drake
References: Albert pers. comm., Chapman et al. 1989, Comer pers. comm., Curtis 1959, MNNHP 1993, Midwestern Ecology Working Group n.d., Rawinski 1984, WNHIP unpubl. data

Northern Pin Oak - (Bur Oak) Forest

***Quercus ellipsoidalis - (Quercus macrocarpa)* Forest**
Northern Pin Oak - (Bur Oak) Forest
Identifier: CEGL002077

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)	Northern Pin Oak - (Bur Oak) Forest
Ecological System(s):	Laurentian Pine-Oak Barrens (CES201.718)
	North-Central Interior Dry Oak Forest and Woodland (CES202.047)

ELEMENT CONCEPT

Global Summary: This northern pin oak - bur oak forest community is found in the upper midwestern United States. Stands are found on sandy, well-drained to excessively well-drained soils. These develop from glacial outwash, glaciofluvial deposits, or alluvial

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sediments. The soils are relatively infertile and acidic. The tree canopy is moderately closed. In Minnesota, it is typically 70-80%. The more open stands tend to have well-developed shrub layers while closed-canopy stands have fewer shrubs. Some stands, especially those in which fire has been excluded for long periods, can have tree densities up to several hundred trees per hectare. *Quercus ellipsoidalis* (northern pin oak) is the dominant tree species and makes up the great majority of the canopy in most stands. Other common tree species include *Pinus banksiana* (jack pine) (especially in Wisconsin), *Populus tremuloides* (quaking aspen), and sometimes *Acer rubrum* (red maple), *Quercus alba* (white oak), *Quercus rubra* (northern red oak), *Quercus velutina* (black oak), *Quercus macrocarpa* (bur oak), and *Prunus serotina* (black cherry). Shrubs such as *Cornus racemosa* (gray dogwood), *Corylus cornuta* (beaked hazelnut), *Juniperus communis* (common juniper), and *Vaccinium* (blueberry) spp. are typical. The ground layer contains species such as *Amphicarpaea bracteata* (American hogpeanut), Asteraceae spp., *Carex pensylvanica* (Pennsylvania sedge), *Geranium maculatum* (spotted geranium), *Maianthemum racemosum* (feathery false lily of the valley), and *Pteridium aquilinum* (western brackenfern).

ENVIRONMENTAL DESCRIPTION

Global Environment: Stands are found on sandy, well-drained to excessively well-drained soils. These develop from glacial outwash, glaciofluvial deposits, or alluvial sediments. The soils are relatively infertile and acidic (Eyre 1980). Stands can be found on flat to moderately sloping sites.

VEGETATION DESCRIPTION

Global Vegetation: The tree canopy is moderately closed, with typically 70-80% cover (MNNHP 1993). The more open stands tend to have well-developed shrub layers while closed-canopy stands have fewer shrubs. Some stands, especially those in which fire has been excluded for long periods, can have tree densities up to several hundred trees per hectare (Curtis 1959). *Quercus ellipsoidalis* (northern pin oak) is the dominant tree species and comprises the great majority of the canopy in most stands. Other common tree species include *Pinus banksiana* (jack pine) (especially in Wisconsin), *Populus tremuloides* (quaking aspen), and sometimes *Acer rubrum* (red maple), *Quercus rubra* (northern red oak), *Quercus macrocarpa* (bur oak), *Quercus velutina* (black oak), and *Prunus serotina* (black cherry). Shrubs such as *Cornus racemosa* (gray dogwood), *Corylus cornuta* (beaked hazelnut), *Juniperus communis* (common juniper), and *Vaccinium* (blueberry) spp. are typical. The ground layer contains species such as *Amphicarpaea bracteata* (American hogpeanut), Asteraceae spp., *Carex pensylvanica* (Pennsylvania sedge), *Geranium maculatum* (spotted geranium), *Maianthemum racemosum* (feathery false lily of the valley), and *Pteridium aquilinum* (western brackenfern).

CONSERVATION STATUS RANK

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

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Global Comments: Stands of this community typically contain at least 50% cover or basal area of *Quercus ellipsoidalis* (northern pin oak). Stands in this association may be similar to stands in the *Quercus velutina - Quercus alba - (Quercus coccinea)* Forest Alliance (A.1911). The type concept in Minnesota was developed by H. Dunevitz (pers. comm. 2000), who considers this type to be absent in subsections 222Lc and 222Lf, where soils are finer, loess-derived and more likely to retain moisture. Stands on drier slopes in these subsections are more likely to resemble dry-mesic stands that are classified as white oak - red oak forests, *Quercus alba - Quercus rubra - Carya ovata* Glaciated Forest (CEGL002068).
Global Similar Associations:
- *Quercus alba - Quercus macrocarpa - Quercus rubra / Corylus americana* Woodland (CEGL002142)
- *Quercus velutina / Carex pensylvanica* Forest (CEGL002078)--is dominated by *Quercus velutina*. In Wisconsin, these two species hybridize and traditionally *Quercus velutina* is treated as occurring south of the tension zone and *Quercus ellipsoidalis* north of it. However, this type has also been reported in Iowa, Illinois and Indiana.

Global Related Concepts:
- Northern Pin Oak: 14 (Eyre 1980) B

ELEMENT DISTRIBUTION

Global Range: This community, found in the upper midwestern United States, ranging from the northern parts of Indiana, Illinois, and Iowa, north to Minnesota, Wisconsin, and possibly Michigan.
Nations: US
States/Provinces: IA:SU, IN?, MI?, MN, WI:S3
TNC Ecoregions: 35:C, 46:C, 47:C, 48:C
USFS Ecoregions (1994/95): 212Hb:CPP, 212Ia:CCC, 212Ja:CPP, 212Jj:CPP, 212Jm:CPP, 212Ka:CCP, 212Kb:CCC, 212Na:CCP, 212Nb:CC?, 212Nc:CCC, 222Lc:C??, 222Lf:C??, 222Ma:CCC, 222Mc:CCC, 222Md:CCC, 251Ba:CCC
Federal Lands: NPS (Apostle Islands, Saint Croix); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Nicolet, Ottawa?)

ELEMENT SOURCES

Apostle Islands National Lakeshore Map Code: FPO
Local Description Authors:
Global Description Authors: D. Faber-Langendoen

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References: Curtis 1959, Eyre 1980, INAI unpubl. data, MNNHP 1993, Midwestern Ecology Working Group n.d., WNHIP unpubl. data

MG159. Northern Pine - Oak Woodland & Barrens

G160. Great Lakes Pine Barrens

Great Lakes Dune Pine Forest

***Pinus banksiana - Pinus resinosa - Pinus strobus* Dune Forest**
Jack Pine - Red Pine - Eastern White Pine Dune Forest
Identifier: CEGL002589

NVC CLASSIFICATION

Division	Eastern North American Cool Temperate Forest (1.C.2.a)
Macrogroup	Northern Pine - Oak Woodland & Barrens (MG159)
Group	Great Lakes Pine Barrens (G160)
Association (Common name)	Great Lakes Dune Pine Forest
Ecological System(s):	Great Lakes Dune (CES201.026)
	Great Lakes Wooded Dune and Swale (CES201.726)

ELEMENT CONCEPT

Global Summary: This pine dune forest is found on dune systems on Lake Superior, Lake Michigan and Lake Huron in the United States and Canada. The canopy is more-or-less closed and is dominated by *Pinus banksiana* (jack pine), *Pinus resinosa* (red pine), and *Pinus strobus* (eastern white pine). This type has not been well-described, and further characterization is needed.

ENVIRONMENTAL DESCRIPTION

Apostle Islands National Lakeshore Environment: This pine dune forest was sampled once in the park on the western end of Long Island. The site is on a south-facing gently sloping stabilized dune at 195 m (637 feet) elevation. The soil is rapidly drained sand. The unvegetated surface is made up of lichens (50% cover), sand (30%), and leaf litter (20%). No budworm damage was noted.
Global Environment: Stands are found on dune systems along Lake Superior, Lake Michigan and Lake Huron.

VEGETATION DESCRIPTION

Apostle Islands National Lakeshore Vegetation: The sparse (20% cover), relatively stunted (5-10 m tall) tree canopy is dominated by *Pinus banksiana* (jack pine), as is the sparse (5%) tall-shrub layer (2-5 m). The moderate (40%) short-shrub layer (0.5-1 m) is dominated by *Juniperus communis* (common juniper) with lesser amounts of *Gaylussacia baccata* (black huckleberry) and *Vaccinium myrtilloides* (velvetleaf huckleberry). *Arctostaphylos uva-ursi* (kinnikinnick), *Epigaea repens* (trailing arbutus), *Hudsonia tomentosa* (woolly beach-heather), and *Vaccinium angustifolium* (lowbush blueberry) form a moderate (40%) dwarf-shrub layer (<0.5 m). The sparse herbaceous layer (5%) includes *Gaultheria procumbens* (eastern teaberry), *Melampyrum lineare* (narrowleaf cowwheat), and *Trientalis borealis* (starflower). State-vulnerable (S3) *Deschampsia flexuosa* (wavy hairgrass) was recorded in the sampled plot. Nonvascular species (mosses and lichens) including *Pleurozium schreberi* (Schreber's big red stem moss) cover 20% of the ground surface.
Global Vegetation: The canopy is more-or-less closed and is dominated by *Pinus banksiana* (jack pine), *Pinus resinosa* (red pine), and *Pinus strobus* (eastern white pine). This type has not been well-described, and further characterization is needed.

MOST ABUNDANT SPECIES

Apostle Islands National Lakeshore

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus banksiana* (jack pine)
Tall shrub/sapling	Needle-leaved shrub	*Pinus banksiana* (jack pine)
Short shrub/sapling	Needle-leaved shrub	*Juniperus communis* (common juniper)
Herb (field)	Dwarf-shrub	*Arctostaphylos uva-ursi* (kinnikinnick)

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Arctostaphylos uva-ursi* (kinnikinnick), *Deschampsia flexuosa* (wavy hairgrass), *Epigaea repens* (trailing arbutus), *Gaultheria procumbens* (eastern teaberry), *Gaylussacia baccata* (black huckleberry), *Hudsonia tomentosa* (woolly beach-heather), *Juniperus communis* (common juniper), *Maianthemum canadense* (Canada mayflower), *Melampyrum lineare* (narrowleaf cowwheat), *Pinus banksiana* (jack pine), *Pleurozium schreberi* (Schreber's big red stem moss), *Quercus rubra* (northern red oak), *Trientalis borealis* (starflower), *Vaccinium angustifolium* (lowbush blueberry), *Vaccinium myrtilloides* (velvetleaf huckleberry)

OTHER NOTEWORTHY SPECIES

Apostle Islands National Lakeshore: Vulnerable: *Deschampsia flexuosa* (wavy hairgrass, state-vulnerable, G5)

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CONSERVATION STATUS RANK

Global Rank & Reasons: G3Q (24-Oct-2002). This type is found within the coastal areas of Lake Superior, Lake Michigan and Lake Huron where it is a component of a complex dune-and-swale system found along the lakeplains. It is primarily restricted to drier, sandy soils on dune tops or ridges. It is listed for the United States, but currently not attributed to Canada. More information on the status of this type is needed.

CLASSIFICATION

Status: Standard
Classification Confidence: 3 - Weak
Global Comments: Type is not described in Ontario by Lee et al. (1998). Its extent in the United States may be limited, and a review of its concept is needed. Perhaps this type can be combined with Great Lakes Pine Barrens, *Pinus banksiana - (Pinus resinosa) - Pinus strobus / Juniperus horizontalis* Wooded Herbaceous Vegetation (CEGL005125), or can be dissolved into the respective *Pinus banksiana* (jack pine), *Pinus resinosa* (red pine) or *Pinus strobus* (eastern white pine) inland forests on sand. Type (whether as forest or barrens) has been eliminated in Illinois.
Global Similar Associations:
- *Pinus banksiana - (Pinus resinosa) - Pinus strobus / Juniperus horizontalis* Wooded Herbaceous Vegetation (CEGL005125)--This is the open Great Lakes pine barrens type.
- *Pinus resinosa / Vaccinium* spp. Forest (CEGL002443)
- *Pinus strobus / Vaccinium* spp. Forest (CEGL002444)

Global Related Concepts:
- Great Lakes Barren (Chapman et al. 1989) B

ELEMENT DISTRIBUTION

Apostle Islands National Lakeshore Range: This pine dune forest was sampled on the western end of Long Island.
Global Range: This pine dune forest type is found on dune systems on Lake Superior, Lake Michigan and Lake Huron in the United States and possibly in Canada, ranging from Wisconsin and Michigan to Ontario, and, at least historically, in Indiana and Illinois.
Nations: CA, US
States/Provinces: IL, IN, MI, ON, QC:S3?, WI
TNC Ecoregions: 48:C
USFS Ecoregions (1994/95): 212Ha:CC?, 212Hb:CC?, 212He:CCC, 212Hh:CC?, 212Hi:CCC, 212Hj:CCC, 212Hk:CC?, 212Hl:CCC, 212Ho:CCC, 212Hr:CCP, 212Hw:CCC, 212Hx:CCC, 212Ia:CCC, 212Ja:CC?, 212Jn:CC?, 212Jr:CCC, 212Oa:CCC, 222Jj:CCC
Federal Lands: NPS (Apostle Islands, Indiana Dunes, Pictured Rocks, Sleeping Bear Dunes); USFS (Hiawatha, Huron-Manistee, Huron?, Manistee)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (1 plot): APIS.222.
Apostle Islands National Lakeshore Map Code: FPD
Local Description Authors: M.J. Russo
Global Description Authors: D. Faber-Langendoen
References: Bakowsky and Lee 1996, Chapman et al. 1989, Farrand and Bell 1982, Lee et al. 1998, Midwestern Ecology Working Group n.d.

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

Red Maple - Ash - Birch Swamp Forest

***Acer rubrum* - *Fraxinus* spp. - *Betula papyrifera / Cornus canadensis* Forest**
Red Maple - Ash species - Paper Birch / Bunchberry Dogwood Forest
Identifier: CEGL002071

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)	Red Maple - Ash - Birch Swamp Forest
Ecological System(s):	Laurentian-Acadian Alkaline Conifer-Hardwood Swamp (CES201.575)

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ELEMENT CONCEPT

Global Summary: This red maple swamp forest type is found in the northern parts of the Great Lakes region of the United States and in adjacent Canada. Stands are typically found on muck and shallow peat on lakeplains and floodplains. The canopy structure is variable, with cover ranging from open (25-60%) to closed (60-100%). Common canopy dominants include *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Betula papyrifera* (paper birch), *Fraxinus nigra* (black ash), *Fraxinus pennsylvanica* (green ash), and occasional *Larix laricina* (tamarack), *Pinus strobus* (eastern white pine), and *Ulmus americana* (American elm) (at least historically). *Pinus strobus* (eastern white pine) may form a patchy supercanopy above the hardwood canopy. Common shrubs include *Alnus incana* (gray alder). *Toxicodendron vernix* (poison-sumac) may be common in parts of the range. Other associates include *Ilex verticillata* (common winterberry), *Ribes* (currant) spp., and *Rubus idaeus* ssp. *strigosus* (grayleaf red raspberry). The herbaceous layer contains *Carex stipata* (owlfruit sedge), *Impatiens capensis* (jewelweed), *Mitella nuda* (naked miterwort), *Onoclea sensibilis* (sensitive fern), *Osmunda cinnamomea* (cinnamon fern), *Osmunda claytoniana* (interrupted fern), *Saxifraga pensylvanica* (eastern swamp saxifrage), and others. A seepage swamp subtype can occur where steep sandy slopes and gravelly slopes merge with a river or stream terrace. The ground layer can be exceptionally diverse, with characteristic seepage species including *Angelica atropurpurea* (purplestem angelica), *Carex bromoides* (bromelike sedge), *Hydrocotyle americana* (American marshpennywort), *Poa paludigena* (bog bluegrass), *Saxifraga pensylvanica* (eastern swamp saxifrage), and *Symplocarpus foetidus* (skunk-cabbage).

ENVIRONMENTAL DESCRIPTION

Global Environment: Stands are typically found on muck and shallow peat on lakeplains and floodplains (MNNHP 1993).

VEGETATION DESCRIPTION

Global Vegetation: The canopy structure is variable, with cover ranging from open (25-60%) to closed (60-100%). Common canopy dominants include *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Betula papyrifera* (paper birch), *Fraxinus nigra* (black ash), *Fraxinus pennsylvanica* (green ash), and occasional *Larix laricina* (tamarack), *Pinus strobus* (eastern white pine), and *Ulmus americana* (American elm) (at least historically). *Pinus strobus* (eastern white pine) may form a patchy supercanopy above the hardwood canopy. Common shrubs include *Alnus incana* (gray alder), and *Toxicodendron vernix* (poison-sumac) may be common in parts of the range. Other associates include *Ilex verticillata* (common winterberry), *Ribes* (currant) spp., and *Rubus idaeus* ssp. *strigosus* (grayleaf red raspberry). The herbaceous layer contains *Carex stipata* (owlfruit sedge), *Impatiens capensis* (jewelweed), *Mitella nuda* (naked miterwort), *Onoclea sensibilis* (sensitive fern), *Osmunda cinnamomea* (cinnamon fern), *Osmunda claytoniana* (interrupted fern), *Saxifraga pensylvanica* (eastern swamp saxifrage), and others (MNNHP 1993, Wovcha et al. 1995). A seepage swamp subtype can occur where steep sandy slopes and gravelly slopes merge with a river or stream terrace. The ground layer can be exceptionally diverse, with characteristic seepage species including *Angelica atropurpurea* (purplestem angelica), *Carex bromoides* (bromelike sedge), *Hydrocotyle americana* (American marshpennywort), *Poa paludigena* (bog bluegrass), *Saxifraga pensylvanica* (eastern swamp saxifrage), and *Symplocarpus foetidus* (skunk-cabbage) (MNNHP 1993, Wovcha et al. 1995).

OTHER NOTEWORTHY SPECIES

Global: Vulnerable: *Dryopteris crinalis* (serpent woodfern, G3), *Poa paludigena* (bog bluegrass, G3), *Rubus hispidoides* (bog dewberry, globally imperiled, G2?Q)

CONSERVATION STATUS RANK

Global Rank & Reasons: G4 (3-Oct-1996). In Wisconsin, where the type is ranked S2, few high-quality occurrences have been documented (E. Epstein pers. comm. 1999).

CLASSIFICATION

Status: Standard

Classification Confidence: 2 - Moderate

Global Comments: Hydrology of this type may be a combination of seasonally flooded and saturated. This type can arise as a result of logging cedar swamps, or where hydrology has been altered (E. Epstein pers. comm. 1999). *Fraxinus nigra* (black ash) is less than 50% of the cover; if greater, then see the *Fraxinus nigra* (black ash) type (CEGL002105). If *Larix laricina* (tamarack) is at least 25% of the canopy, then see *Larix laricina - Acer rubrum / (Rhamnus alnifolia, Vaccinium corymbosum* (highbush blueberry)) Forest (CEGL005232) or *Larix laricina / Alnus incana* Forest (CEGL002471).

Global Similar Associations:

- *Fraxinus nigra* - Mixed Hardwoods - Conifers / *Cornus sericea / Carex* spp. Forest (CEGL002105)--This type is dominated by *Fraxinus nigra* and is more northern in distribution.
- *Larix laricina - Acer rubrum / (Rhamnus alnifolia, Vaccinium corymbosum)* Forest (CEGL005232)--This type contains significant *Larix laricina* (generally at least 25%, and more typically over 50% cover) and *Acer rubrum* (at least 25%). May overlap in concept.
- *Larix laricina / Alnus incana* Forest (CEGL002471)--This type is a rich swamp, with *Larix laricina* as the dominant (generally >50% cover).
- *Symplocarpus foetidus* Herbaceous Vegetation (CEGL002385)

Global Related Concepts:

- Southern Swamp (Chapman et al. 1989) B

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ELEMENT DISTRIBUTION

Global Range: This red maple swamp forest type is found in the northern parts of the Great Lake states region of the United States and in adjacent Canada, ranging from Minnesota east to Michigan and Ontario.
Nations: CA, US
States/Provinces: MI, MN, ON, QC, WI:S2?
TNC Ecoregions: 35:C, 45:P, 46:C, 47:C, 48:C
USFS Ecoregions (1994/95): 212He:CCP, 212Hl:CCP, 212Hm:CCP, 212Hn:CCP, 212Ho:CCP, 212Hp:CCP, 212Hq:CCP, 212Hr:CCP, 212Hs:CCP, 212Ht:CCP, 212Hu:CCP, 212Hv:CCC, 212Hw:CCP, 212Hx:CCP, 212Hy:CCP, 212Ia:CCC, 212Ja:CPP, 212Jb:CPP, 212Jc:CPP, 212Jl:CPP, 212Jn:CPP, 212Jo:CPP, 212Kb:CCC, 212La:CPP, 212Mb:CPP, 212Na:CCP, 212Nb:CCP, 212Nc:CCC, 222Jc:CCC, 222Jg:CCC, 222Mc:CCC, 222Md:CCC, 222Na:CCC
Federal Lands: NPS (Apostle Islands, Isle Royale, Saint Croix, Sleeping Bear Dunes); USFS (Chequamegon-Nicolet?, Chequamegon?, Chippewa, Huron-Manistee, Huron?, Manistee, Nicolet?, Ottawa)

ELEMENT SOURCES

Apostle Islands National Lakeshore Map Code: FRM
Local Description Authors:
Global Description Authors: D. Faber-Langendoen
References: Chapman et al. 1989, Epstein pers. comm., MNNHP 1993, Midwestern Ecology Working Group n.d., WNHIP unpubl. data, Wovcha et al. 1995

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
Ecological System(s):	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* (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

Apostle Islands National Lakeshore Environment: This black ash - hardwood swamp forest was sampled once on Sand Island. The site is a seasonally (spring) flooded, flat step-in-slope of a moraine at 200 m (661 feet) elevation. The soil is a moderately well-drained sandy loam. The unvegetated surface is made up of leaf litter (30% cover), wood (30%) and bare soil (40%). No evidence of disturbance was reported.
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

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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

Apostle Islands National Lakeshore Vegetation: The moderate (40% cover) tree canopy, 20-35 m tall, is comprised of *Abies balsamea* (balsam fir), *Betula papyrifera* (paper birch), and *Populus tremuloides* (quaking aspen). The moderate (60%) subcanopy (10-15 m) is dominated by *Fraxinus nigra* (black ash). The moderate (40%) tall-shrub layer (2-5 m) includes *Acer spicatum* (mountain maple), *Alnus incana* ssp. *rugosa* (speckled alder), *Cornus sericea* (red-osier dogwood), *Fraxinus nigra* (black ash), and *Viburnum opulus* var. *americanum* (American cranberrybush). The sparse (10%) short-shrub layer (0.5-1 m) includes *Lonicera canadensis* (American fly honeysuckle) and *Rubus* (blackberry) sp. The moderate herbaceous layer (60%) is dominated by *Calamagrostis canadensis* (bluejoint) and includes *Athyrium filix-femina* (common ladyfern), *Carex intumescens* (greater bladder sedge), *Dryopteris carthusiana* (spinulose woodfern), *Epilobium ciliatum* (fringed willowherb), *Equisetum arvense* (field horsetail), *Glyceria striata* (fowl mannagrass), and *Impatiens capensis* (jewelweed), among others. Nonvascular species (mosses and lichens) cover 30% 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

Apostle Islands National Lakeshore

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Populus tremuloides* (quaking aspen)
Tree subcanopy	Broad-leaved deciduous tree	*Fraxinus nigra* (black ash)
Herb (field)	Graminoid	*Calamagrostis canadensis* (bluejoint)

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Abies balsamea* (balsam fir), *Acer spicatum* (mountain maple), *Betula papyrifera* (paper birch), *Calamagrostis canadensis* (bluejoint), *Carex intumescens* (greater bladder sedge), *Cornus sericea* (red-osier dogwood), *Fraxinus nigra* (black ash), *Populus tremuloides* (quaking aspen)

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).

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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

Apostle Islands National Lakeshore Range: This black ash - hardwood swamp forest was sampled on Sand Island.
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, 212Jj: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)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (1 plot): APIS.131.
Apostle Islands National Lakeshore Map Code: FBA
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, WNHIP unpubl. data, Wovcha et al. 1995

White-cedar - Black Ash Swamp

***Thuja occidentalis - Fraxinus nigra* Forest**
Northern White-cedar - Black Ash Forest
Identifier: CEGL005165

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)	White-cedar - Black Ash Swamp
Ecological System(s):	Laurentian-Acadian Alkaline Conifer-Hardwood Swamp (CES201.575)
	Great Lakes Wooded Dune and Swale (CES201.726)

ELEMENT CONCEPT

Global Summary: This white-cedar - black ash forest is found in the sub-boreal regions of the Great Lakes in the United States and Canada where it occurs on wet, saturated soils. Substrate is well-decomposed peat, and hummocky topography is present. Canopy cover is variable, sometimes fairly open. *Thuja occidentalis* (northern white-cedar) and *Fraxinus nigra* (black ash) dominate the canopy, but some stands may have *Fraxinus* (ash) in the upper canopy and *Thuja occidentalis* (northern white-cedar) in the lower canopy. *Thuja occidentalis* (northern white-cedar) tends to occur on the hummocks and *Fraxinus* (ash) in the hollows. *Populus tremuloides* (quaking aspen) can be a major component, but this may be caused by logging of *Thuja occidentalis* (northern white-cedar). *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), and *Picea glauca* (white spruce) may also be present. Shrubs include *Acer spicatum* (mountain maple), *Cornus alternifolia* (alternateleaf dogwood), *Lonicera canadensis* (American fly honeysuckle), *Ribes* (currant) spp., and *Rubus pubescens* (dwarf red blackberry). The herb layer includes *Aralia nudicaulis* (wild sarsaparilla), *Arisaema triphyllum* (Jack in the pulpit), *Clintonia borealis* (bluebead), *Cornus canadensis* (bunchberry dogwood), *Dryopteris carthusiana* (spinulose woodfern), *Galium triflorum* (fragrant bedstraw), *Maianthemum canadense* (Canada mayflower), *Tiarella cordifolia* (heartleaf foamflower) and *Trientalis borealis* (starflower).

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ENVIRONMENTAL DESCRIPTION

Global Environment: Stands occur on wet, saturated soils. Substrate is either wet mineral soils or well-decomposed peat, and hummocky topography is present.

VEGETATION DESCRIPTION

Global Vegetation: Canopy cover is variable, sometimes fairly open. *Thuja occidentalis* (northern white-cedar) and *Fraxinus nigra* (black ash) dominate the canopy, but some stands may have *Fraxinus* (ash) in the upper canopy and *Thuja occidentalis* (northern white-cedar) in the lower canopy. *Thuja occidentalis* (northern white-cedar) tends to occur on the hummocks and *Fraxinus* (ash) in the hollows. *Populus tremuloides* (quaking aspen) can be a major component, but this may be caused by logging of *Thuja occidentalis* (northern white-cedar). *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), and *Picea glauca* (white spruce) may also be present. Shrubs include *Acer spicatum* (mountain maple), *Cornus alternifolia* (alternateleaf dogwood), *Lonicera canadensis* (American fly honeysuckle), *Ribes* (currant) spp., and *Rubus pubescens* (dwarf red blackberry). The herb rich layer includes *Aralia nudicaulis* (wild sarsaparilla), *Arisaema triphyllum* (Jack in the pulpit), *Clintonia borealis* (bluebead), *Cornus canadensis* (bunchberry dogwood), *Dryopteris carthusiana* (spinulose woodfern), *Galium triflorum* (fragrant bedstraw), *Maianthemum canadense* (Canada mayflower), *Tiarella cordifolia* (heartleaf foamflower), and *Trientalis borealis* (starflower) (Chambers et al. 1997).

OTHER NOTEWORTHY SPECIES

Global: Vulnerable: *Rubus hispidoides* (bog dewberry, globally imperiled, G2?Q)

CONSERVATION STATUS RANK

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

CLASSIFICATION

Status: Standard
Classification Confidence: 3 - Weak
Global Comments: This type occurs on wet hummocky soils. Soils may be more minerotrophic than those found in pure white-cedar swamps. This type may better fit into a mixed conifer-hardwood category. Type may also be the same as *Thuja occidentalis - Acer rubrum / Cornus sericea* Forest (CEGL006199) or the White Cedar - (Mixed Conifer) / Alder Swamp, *Thuja occidentalis - (Picea mariana, Abies balsamea) / Alnus incana* Forest (CEGL002456). It may also be in Minnesota (Norm Aaseng). Distinctions at the association level are not clear, but will be reviewed as part of a Minnesota statewide analysis.
Global Similar Associations:
- *Thuja occidentalis - (Picea mariana, Abies balsamea) / Alnus incana* Forest (CEGL002456)--A pure evergreen cedar swamp type.
- *Thuja occidentalis - Acer rubrum / Cornus sericea* Forest (CEGL006199)--A more southerly distributed type.

Global Related Concepts:
- Hardwood-Conifer Swamp (Chapman et al. 1989) B
- White Cedar-Hardwoods-Fragrant Bedstraw-Herb Rich (V8) (Chambers et al. 1997) =

ELEMENT DISTRIBUTION

Global Range: This white-cedar - black ash swamp type is found in the northern Great Lakes region of the United States and Canada.
Nations: CA, US
States/Provinces: MI, MN, ON, WI
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:CCC, 212Hm:CCC, 212Hn:CCP, 212Ho:CCC, 212Hp:CCP, 212Hq:CCP, 212Hr:CCP, 212Hs:CCC, 212Ht:CCC, 212Hu:CCP, 212Hv:CCC, 212Hw:CCC, 212Ia:CCC, 212Ja:CCP, 212Jb:CCC, 212Jc:CCP, 212Jk:CCP, 212Jl:CCP, 212Jn:CCP, 212Jo:CCP, 212Jr:CCP, 222If:CCC, 222Jc:CCC, 222Jg:CCC, 222Jh:CCC, 222Jj:CCC
Federal Lands: NPS (Apostle Islands, Isle Royale, Pictured Rocks, Saint Croix, Sleeping Bear Dunes, Voyageurs); USFS (Huron, Huron-Manistee, Ottawa, Superior?)

ELEMENT SOURCES

Apostle Islands National Lakeshore Map Code: FCA
Local Description Authors:
Global Description Authors: D. Faber-Langendoen
References: Chambers et al. 1997, Chapman et al. 1989, Midwestern Ecology Working Group n.d.

Hemlock - Yellow Birch Swamp Wet-Mesic Forest

***Tsuga canadensis - Betula alleghaniensis* Saturated Forest**
Eastern Hemlock - Yellow Birch Saturated Forest
Identifier: CEGL005003

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)

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Association (Common name) Hemlock - Yellow Birch Swamp Wet-Mesic Forest
Ecological System(s): Laurentian-Acadian Alkaline Conifer-Hardwood Swamp (CES201.575)

ELEMENT CONCEPT

Global Summary: This community is found in the central Great Lakes region of the United States and adjacent Canada. Stands occur on wet-mesic areas with imperfectly drained sandy loam/loam or silty clay soils that are often saturated. These areas occur on gentle slopes, drainageways, and bordering lakes and wetlands. The nutrient status is generally poor to medium. The overstory of this community is composed of conifers with a moderate amount of deciduous trees. *Tsuga canadensis* (eastern hemlock) is usually the most abundant species with *Acer rubrum* (red maple), *Acer saccharum* (sugar maple), *Betula alleghaniensis* (yellow birch), *Pinus strobus* (eastern white pine), and *Thuja occidentalis* (northern white-cedar) less common. *Abies balsamea* (balsam fir) in northern Wisconsin and Michigan. The shrub layer is not well-developed in mature stands with dense canopies, but shrubs are often abundant in disturbed or young stands. Shrubs that may be present include *Amelanchier* (serviceberry) spp., *Corylus cornuta* (beaked hazelnut), *Lonicera canadensis* (American fly honeysuckle), *Prunus pensylvanica* (pin cherry), and *Vaccinium* (blueberry) spp. Common herbaceous species include *Clintonia borealis* (bluebead), *Coptis trifolia* (threeleaf goldthread), *Cornus canadensis* (bunchberry dogwood), *Dryopteris carthusiana* (spinulose woodfern), *Maianthemum canadense* (Canada mayflower), *Trientalis borealis* (starflower), *Viola* (violet) spp., and others.

ENVIRONMENTAL DESCRIPTION

Global Environment: This community is typically found on wet-mesic areas with imperfectly drained loamy sand, sandy loam, and loam soils that are often saturated. These areas occur on gentle slopes, drainageways, and bordering lakes and wetlands. The nutrient status is generally poor to medium (Kotar et al. 1988).

VEGETATION DESCRIPTION

Global Vegetation: The overstory of this community is composed of conifers with a moderate amount of deciduous trees. *Tsuga canadensis* (eastern hemlock) is usually the most abundant species with *Abies balsamea* (balsam fir), *Acer rubrum* (red maple), *Acer saccharum* (sugar maple), *Betula alleghaniensis* (yellow birch), *Picea glauca* (white spruce), *Pinus strobus* (eastern white pine), and *Thuja occidentalis* (northern white-cedar) less common. The shrub layer is not well-developed in mature stands with dense canopies, but shrubs are often abundant in disturbed or young stands. Shrubs that may be present include *Amelanchier* (serviceberry) spp., *Corylus cornuta* (beaked hazelnut), *Lonicera canadensis* (American fly honeysuckle), *Prunus pensylvanica* (pin cherry), and *Vaccinium* (blueberry) spp. Common herbaceous species include *Clintonia borealis* (bluebead), *Coptis trifolia* (threeleaf goldthread), *Cornus canadensis* (bunchberry dogwood), *Dryopteris carthusiana* (spinulose woodfern), *Maianthemum canadense* (Canada mayflower), *Oxalis montana* (mountain woodsorrel), *Trientalis borealis* (starflower), *Viola* (violet) spp., and others.

CONSERVATION STATUS RANK

Global Rank & Reasons: G3 (22-Jun-1998). This type is fairly widespread in, e.g., Wisconsin, but few good occurrences have been recorded (E. Epstein pers. comm. 1999).

CLASSIFICATION

Status: Standard
Classification Confidence: 3 - Weak
Global Comments: Type probably varies from mixed evergreen-deciduous to evergreen, with at least 25% *Tsuga canadensis* (eastern hemlock) present (cover or basal area), and the rest either hardwoods or some conifers. If *Thuja occidentalis* (northern white-cedar) is prominent (>50% cover (or basal area?) of the conifer component?), place with *Thuja occidentalis* (northern white-cedar) white-cedar types, such as *Thuja occidentalis - (Picea mariana, Abies balsamea) / Alnus incana* Forest (CEGL002456). Mixed stands of *Thuja* (red cedar) and *Tsuga* (hemlock) have been identified on the Chequamegon National Forest in Wisconsin, and are currently placed with this *Tsuga* (hemlock) type until field verification can be conducted (M. Brzeskiewicz pers. comm. 1997). Type may equal *Tsuga canadensis - Betula alleghaniensis / Ilex verticillata / Sphagnum* spp. Forest (CEGL006226) in the Northeast, but would make a broad type. Stands in northeastern Ohio are placed with CEGL006226, found in New York and the northeastern United States. Ohio stands have no *Rhododendron* (rhododendron) spp. (at least, not currently), and appear to resemble CEGL006226 more than CEGL006279. In Michigan this type is found in Gogebic and Iron counties in the western Upper Peninsula.
Global Similar Associations:
- *Thuja occidentalis - (Picea mariana, Abies balsamea) / Alnus incana* Forest (CEGL002456)
- *Tsuga canadensis - Betula alleghaniensis / Ilex verticillata / Sphagnum* spp. Forest (CEGL006226)
- *Tsuga canadensis / Rhododendron maximum / Sphagnum* spp. Forest (CEGL006279)

Global Related Concepts:
- *Tsuga / Maianthemum - Coptis* (Kotar et al. 1988) =
- Rich Conifer Swamp (Chapman et al. 1989) ?

ELEMENT DISTRIBUTION

Global Range: This community is found in the central Great Lakes region of the United States and adjacent Canada, ranging from northern Wisconsin to southern Ontario.
Nations: CA, US
States/Provinces: MI, OH, ON:S3S4, WI:S2S4
TNC Ecoregions: 47:C, 48:C

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USFS Ecoregions (1994/95): 212Ha:CCC, 212Hb:CCP, 212Hh:CCP, 212Hi:CCC, 212Hl:CCP, 212Hm:CCP, 212Ho:CCC, 212Hr:CCP, 212Ht:CCP, 212Hu:CCP, 212Hv:CC?, 212Hw:CCC, 212Ia:CCC, 212Ja:CPP, 212Jb:CPP, 212Jc:CPP, 212Jf:CPP, 212Jl:CPP, 212Jm:CPP, 212Jn:CPP, 212Jo:CPP, 222Ia:CCC, 222Ja:CCC
Federal Lands: NPS (Apostle Islands, Pictured Rocks, Sleeping Bear Dunes); USFS (Chequamegon, Chequamegon-Nicolet, Hiawatha?, Huron-Manistee, Huron?, Manistee, Nicolet, Ottawa)

ELEMENT SOURCES

Apostle Islands National Lakeshore Map Code: FHS
Local Description Authors:
Global Description Authors: J. Drake
References: Chapman et al. 1989, Epstein pers. comm., Kotar et al. 1988, Midwestern Ecology Working Group n.d., 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: CEGL002381

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
Ecological System(s):	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 by be dominated or codominated by the Central Appalachian endemic *Ilex collina* (longstalk holly). The herbaceous layer contains species such as *Symphyotrichum lanceolatum* var. *lanceolatum* (white panicle aster), *Symphyotrichum puniceum* (purplestem aster), *Calamagrostis canadensis* (bluejoint), *Caltha palustris* (yellow marsh-marigold), *Carex lacustris* (hairy sedge), *Carex prairea* (prairie sedge), *Carex trisperma* (threeseeded sedge), *Doellingeria umbellata* (parasol whitetop), *Eupatorium maculatum* (spotted joepyeweed), *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

Apostle Islands National Lakeshore Environment: This alder swamp community was sampled once on at once on Long Island, Quarry Bay on Stockton Island, and once on Sand Island. The first site is a flat, seasonally flooded fen with well-drained sand soil, the second a seasonally flooded draw with very poorly drained clay loam soil, and the third a flat depression with poorly drained muck that likely becomes very wet in spring and following heavy rain events. The unvegetated surface is made up of leaf litter (35-100% cover) and bare soil (50-65%). No evidence of disturbance was reported.
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

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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

Apostle Islands National Lakeshore Vegetation: Stands of this community can be varied both in structure and density. The Stockton Island stand is comprised of a denser (90% cover) and taller (5-10 m) shrub layer than the Sand Island stand which is moderately dense (70%) and shorter (2-5 m), while the Long Island stand has a sparse (10%) tall-shrub layer (2-5 m) and moderately dense (70%) short-shrub layer (1-2 m). Stands are clearly dominated by *Alnus incana* ssp. *rugosa* (speckled alder) and little else, although *Cornus sericea* (red-osier dogwood), *Fraxinus nigra* (black ash), *Myrica gale* (sweetgale), and *Rubus* (blackberry) sp. may also be present. The moderately sparse to dense (40-80%) herbaceous layer may be dominated by *Calamagrostis canadensis* (bluejoint), *Carex lacustris* (hairy sedge), or *Impatiens capensis* (jewelweed). Other species include *Carex ovalis* (eggbract sedge), *Carex utriculata* (Northwest Territory sedge), *Euthamia graminifolia* (flat-top goldentop), *Glyceria canadensis* (rattlesnake mannagrass), *Lycopus uniflorus* (northern bugleweed), and *Phacelia argentea* (sanddune phacelia), among others. Nonvascular species (mosses) 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* (steeplebush), and *Viburnum* (viburnum) spp., can be found. The herbaceous layer contains species such as *Symphyotrichum lanceolatum* var. *lanceolatum* (white panicle aster), *Symphyotrichum puniceum* (purplestem aster), *Calamagrostis canadensis* (bluejoint), *Caltha palustris* (yellow marsh-marigold), *Carex lacustris* (hairy sedge), *Carex prairea* (prairie sedge), *Carex trisperma* (threeseeded sedge), *Doellingeria umbellata* (parasol whitetop), *Eupatorium maculatum* (spotted joepyeweed), *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, Sperduto 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

Apostle Islands National Lakeshore

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Alnus incana* ssp. *rugosa* (speckled alder)
Herb (field)	Forb	*Impatiens capensis* (jewelweed)
Herb (field)	Graminoid	*Carex lacustris* (hairy sedge)

Global

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Alnus incana* (gray alder)

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Alnus incana* ssp. *rugosa* (speckled alder), *Calamagrostis canadensis* (bluejoint), *Carex lacustris* (hairy sedge), *Impatiens capensis* (jewelweed)
Global: *Alnus incana* (gray alder)

OTHER NOTEWORTHY SPECIES

Apostle Islands National Lakeshore: Exotic/Invasive: *Lythrum salicaria* (purple loosestrife, exotic, High)
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*

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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
- *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

Apostle Islands National Lakeshore Range: This alder swamp community was sampled on Long Island, at Quarry Bay on Stockton Island, and on Sand Island.

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, 212Jj:CCP, 212Jk:CCP, 212Jl:CCP, 212Jm:CCP, 212Jn:CCP, 212Jo:CCP, 212Jr:CCC, 212Ka:CCP, 212Kb:CCC, 212La:CCC, 212Lb:CCC, 212Mb:CPP, 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)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (3 plots): APIS.103, APIS.122, APIS.701.

Apostle Islands National Lakeshore Map Code: SAS

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

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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

Black Spruce / Feathermoss Forest

***Picea mariana / Pleurozium schreberi* Forest**
Black Spruce / Feathermoss Forest
Identifier: CEGL002447

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)	Black Spruce / Feathermoss Forest
Ecological System(s):	Boreal Jack Pine-Black Spruce Forest (CES103.022)

ELEMENT CONCEPT

Global Summary: This black spruce / feathermoss forest is found widely throughout the boreal regions of Canada and into adjacent areas of the midwestern United States. Stands occur on level to gently sloping ground. Soils are typically moderately well-drained, coarse loams, sands, and silts. The canopy of this community is closed and heavily dominated by *Picea mariana* (black spruce) with small amounts of *Abies balsamea* (balsam fir), *Betula papyrifera* (paper birch), *Picea glauca* (white spruce), *Pinus banksiana* (jack pine), and *Populus tremuloides* (quaking aspen). The shrub and herb layers are poorly developed. Species that are most abundant in these layers include the shrubs *Corylus cornuta* (beaked hazelnut), *Gaultheria procumbens* (eastern teaberry), *Ledum groenlandicum* (bog Labrador-tea), *Rosa acicularis* (prickly rose), *Vaccinium angustifolium* (lowbush blueberry), and *Vaccinium myrtilloides* (velvetleaf huckleberry) and the herbs *Eurybia macrophylla* (bigleaf aster), *Cornus canadensis* (bunchberry dogwood), *Equisetum arvense* (field horsetail), and *Maianthemum canadense* (Canada mayflower). Feathermosses, particularly *Pleurozium schreberi* (Schreber's big red stem moss), are very abundant.

ENVIRONMENTAL DESCRIPTION

Apostle Islands National Lakeshore Environment: This black spruce / feathermoss forest was sampled once on Stockton Island tombolo. The site is a flat ridgetop with rapidly drained sand soil. The ground surface is dominated by leaf litter (75% cover) with some wood (5%), dead plant stems (5%), and feathermosses (15%). No evidence of disturbance was reported.
Global Environment: This community is found on level to gently sloping ground. Soils are typically moderately well-drained, coarse loams, sands, and silts (Sims et al. 1989).

VEGETATION DESCRIPTION

Apostle Islands National Lakeshore Vegetation: The moderate (50% cover) tree canopy, 15-20 m tall, is dominated by *Picea mariana* (black spruce) along with *Betula papyrifera* (paper birch) and *Pinus resinosa* (red pine). There may be a few scattered shrubs (0.5-2 m) of *Amelanchier* (serviceberry) sp. and *Vaccinium myrtilloides* (velvetleaf huckleberry). *Vaccinium angustifolium* (lowbush blueberry) forms a sparse (10%) dwarf-shrub layer. The sparse (30%) herbaceous layer is dominated by *Pteridium aquilinum* (western brackenfern) and includes *Gaultheria procumbens* (eastern teaberry), *Maianthemum canadense* (Canada mayflower), and *Melampyrum lineare* (narrowleaf cowwheat). *Pleurozium schreberi* (Schreber's big red stem moss) is the dominant nonvascular species with 40% cover.
Global Vegetation: The canopy of this community is closed and strongly dominated by *Picea mariana* (black spruce) with small amounts of *Abies balsamea* (balsam fir), *Betula papyrifera* (paper birch), *Picea glauca* (white spruce), *Pinus banksiana* (jack pine), and *Populus tremuloides* (quaking aspen). The shrub and herb layers are poorly developed (Grigal and Ohmann 1975). Species that are most abundant in these layers include the shrubs *Corylus cornuta* (beaked hazelnut), *Gaultheria procumbens* (eastern teaberry), *Ledum groenlandicum* (bog Labrador-tea), *Rosa acicularis* (prickly rose), *Vaccinium angustifolium* (lowbush blueberry), and *Vaccinium myrtilloides* (velvetleaf huckleberry), and the herbs *Eurybia macrophylla* (bigleaf aster), *Cornus canadensis* (bunchberry dogwood), *Equisetum arvense* (field horsetail), and *Maianthemum canadense* (Canada mayflower). Feathermosses, particularly *Pleurozium schreberi* (Schreber's big red stem moss), are very abundant. Mosses may cover from 23% (Grigal and Ohmann 1975) to over 85% (Sims et al. 1989) of the forest floor.

MOST ABUNDANT SPECIES

Apostle Islands National Lakeshore

Stratum	Lifeform	Species
Nonvascular	Moss	*Pleurozium schreberi* (Schreber's big red stem moss)

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CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Picea mariana* (black spruce), *Pinus resinosa* (red pine), *Pleurozium schreberi* (Schreber's big red stem moss), *Pteridium aquilinum* (western brackenfern), *Vaccinium angustifolium* (lowbush blueberry)

OTHER NOTEWORTHY SPECIES

Global: Other: *Regulus satrapa* (golden-crowned kinglet, G5)

CONSERVATION STATUS RANK

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

CLASSIFICATION

Status: Standard
Classification Confidence: 1 - Strong
Global Comments: Portions of this type (as described by Sims et al. 1989, V34) can be somewhat poorly drained, bordering on wetland types, such as *Picea mariana - (Larix laricina) / Ledum groenlandicum / Sphagnum* spp. Forest (CEGL005271) (Sims et al. 1989, V35 or V37). There is a sparse vascular cover and few shrubs. The distribution of the type may be more fire-related in the southern part of range and less fire-dependent further north. These forests are not well understood in the northeastern United States. The abundance of black spruce and the often small stature of the canopy trees suggest that hydrological and soil conditions may be limiting for many "upland" species.
Global Similar Associations:
- *Picea mariana - (Larix laricina) / Ledum groenlandicum / Sphagnum* spp. Forest (CEGL005271)
- *Picea mariana - Picea rubens / Pleurozium schreberi* Forest (CEGL006361)
- *Picea mariana - Populus tremuloides* / Mixed Herbs Forest (CEGL002516)
- *Pinus banksiana - Picea mariana / Vaccinium* spp. / *Pleurozium schreberi* Forest (CEGL002448)

Global Related Concepts:
- Black Spruce - Feathermoss Forest (Grigal and Ohmann 1975) =
- Black Spruce / Feathermoss Forest (Zoladeski et al. 1995) =
- Black Spruce / Feathermoss Forest (V33) (Sims et al. 1989) =
- Black Spruce / Labrador Tea / Feathermoss (Sphagnum) (V34) (Sims et al. 1989) F

ELEMENT DISTRIBUTION

Apostle Islands National Lakeshore Range: This black spruce / feathermoss forest occurs on Stockton Island tombolo.
Global Range: This black spruce / feathermoss forest type is found widely throughout the boreal regions of Canada, and into adjacent areas of the midwestern United States.
Nations: CA, US
States/Provinces: MB:S4, MI, MN:S4, ON, QC:S4, WI
TNC Ecoregions: 47:C, 48:C
USFS Ecoregions (1994/95): 212Hi:CCC, 212Ia:CCC, 212Ib:CCC, 212J:CC, 212La:CCC, 212M:CC
Federal Lands: NPS (Apostle Islands, Isle Royale, Pictured Rocks, Voyageurs); USFS (Superior)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (1 plot): APIS.008.
Apostle Islands National Lakeshore Map Code: FBS
Local Description Authors: M.J. Russo
Global Description Authors: J. Drake, mod. D. Faber-Langendoen
References: Greenall 1996, Grigal and Ohmann 1975, MENHP 1991, MNNHP 1993, Midwestern Ecology Working Group n.d., Reschke 1990, Sims et al. 1989, Zoladeski et al. 1995

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

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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* (twinflower), *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* (twinflower), *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, Pictured Rocks, Voyageurs); USFS (Superior?)

ELEMENT SOURCES

Apostle Islands National Lakeshore 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

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Jack Pine / Blueberry / Feathermoss Forest

***Pinus banksiana / Vaccinium* spp. / *Pleurozium schreberi* Forest**

Jack Pine / Blueberry species / Feathermoss Forest

Identifier: CEGL002441

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 / Blueberry / Feathermoss Forest
Ecological System(s):	Boreal Jack Pine-Black Spruce Forest (CES103.022)
	Laurentian Pine-Oak Barrens (CES201.718)

ELEMENT CONCEPT

Global Summary: This jack pine forest is found in the northern parts of the midwestern United States and in central Canada, with disjunct occurrences in the far northeastern United States. Sites occupy flat to rolling topography. The soils are sandy loams, fine sands, and loamy sands, shallow to deep, and with low organic content. The overstory of this forest community is largely made up of moderately to densely spaced conifers with a scattering of deciduous trees. The trees in this community are typically 15-20 m tall. *Pinus banksiana* (jack pine) is often the only tree of significance in the overstory. In some stands, smaller amounts of *Betula papyrifera* (paper birch), *Picea mariana* (black spruce), *Pinus resinosa* (red pine), and *Populus tremuloides* (quaking aspen) may be found. Tall shrubs are uncommon, but may occur in patches. The most common of these are *Alnus viridis* (green alder) and *Amelanchier alnifolia* (Saskatoon serviceberry). In the Midwest, occasional grubs of *Quercus ellipsoidalis* (northern pin oak) and *Quercus macrocarpa* (bur oak) may be present. Low shrubs are abundant. These include *Arctostaphylos uva-ursi* (kinnikinnick), *Diervilla lonicera* (northern bush honeysuckle), *Juniperus communis* (common juniper), *Linnaea borealis* (twinflower), *Rosa acicularis* (prickly rose), and *Vaccinium* (blueberry) spp. The herbaceous layer contains many species typical of northern coniferous forests, such as *Aralia nudicaulis* (wild sarsaparilla), *Anemone quinquefolia* (nightcaps), *Cornus canadensis* (bunchberry dogwood), *Fragaria virginiana* (Virginia strawberry), *Maianthemum canadense* (Canada mayflower), and *Trientalis borealis* (starflower). Mosses, especially *Pleurozium schreberi* (Schreber's big red stem moss), form a nearly continuous carpet.

ENVIRONMENTAL DESCRIPTION

Apostle Islands National Lakeshore Environment: This jack pine forest was sampled twice on Long Island. The sites are gentle to moderate northeast-facing slopes on ridges and dunes at 182 to 200 m (597-660 feet) elevation. Soils are rapidly drained sand. The unvegetated surface is made up of leaf litter (5-65% cover), wood (0-10%), and lichens (30-85%).

Global Environment: This community is found on flat to rolling topography, such as glaciofluvial and lacustrine deposits, moraines, and other glacial features. The soils are sandy loams, fine sands, and loamy sands, shallow to deep, and with low organic content (Sims et al. 1989, MNNHP 1993). In Wisconsin, stands are found on the "sandscapes" of the Apostle Islands (E. Epstein pers. comm. 1999, NatureServe unpubl. data 2005).

VEGETATION DESCRIPTION

Apostle Islands National Lakeshore Vegetation: The moderate (50-60% cover) tree canopy, 10-20 m tall, is dominated by *Pinus banksiana* (jack pine). The very sparse (0-5%) subcanopy (5-10 m) and sparse (5%) tall-shrub (1-5 m) layer includes *Quercus ellipsoidalis* (northern pin oak) and *Pinus strobus* (eastern white pine). The sparse to moderate (20-60%) short-shrub layer (0.5-1 m) is dominated by *Juniperus communis* (common juniper) with lesser amounts of *Gaylussacia baccata* (black huckleberry) and *Vaccinium myrtilloides* (velvetleaf huckleberry). *Arctostaphylos uva-ursi* (kinnikinnick), *Epigaea repens* (trailing arbutus), *Hudsonia tomentosa* (woolly beach-heather), and *Vaccinium angustifolium* (lowbush blueberry) form a moderate (20%) dwarf-shrub layer (<0.5 m). The sparse herbaceous layer (10%) includes *Gaultheria procumbens* (eastern teaberry), *Lycopodium annotinum* (stiff clubmoss), *Maianthemum canadense* (Canada mayflower), *Melampyrum lineare* (narrowleaf cowwheat), and *Trientalis borealis* (starflower), among others. State-vulnerable (S3) *Deschampsia flexuosa* (wavy hairgrass) was recorded in both sampled plots. Nonvascular species (mosses and lichens) including *Pleurozium schreberi* (Schreber's big red stem moss) cover 60-70% of the ground surface.

Global Vegetation: The overstory of this forest community is dominated by moderately to densely spaced conifers with a scattering of deciduous trees. The trees in this community are typically 15-20 m tall (Mueller-Dombois 1964). *Pinus banksiana* (jack pine) is often the only tree of significance in the overstory (Mueller-Dombois 1964, MNNHP 1993). In some stands, smaller amounts of *Betula papyrifera* (paper birch), *Picea mariana* (black spruce), *Pinus resinosa* (red pine), and *Populus tremuloides* (quaking aspen) may be found. Tall shrubs are uncommon, but may occur in patches (Sims et al. 1989). The most common of these are *Alnus viridis* (green alder) and *Amelanchier alnifolia* (Saskatoon serviceberry). In the Midwest, occasional grubs of *Quercus ellipsoidalis* (northern pin oak) and *Quercus macrocarpa* (bur oak) may be present. Low shrubs are abundant. These include *Arctostaphylos uva-ursi* (kinnikinnick), *Diervilla lonicera* (northern bush honeysuckle), *Juniperus communis* (common juniper), *Linnaea borealis* (twinflower), *Rosa acicularis* (prickly rose), and *Vaccinium* (blueberry) spp. The herbaceous layer contains many species typical of northern coniferous forests, such as *Aralia nudicaulis* (wild sarsaparilla), *Anemone quinquefolia* (nightcaps), *Cornus canadensis* (bunchberry dogwood), *Fragaria virginiana* (Virginia strawberry), *Maianthemum canadense* (Canada mayflower), and *Trientalis borealis* (starflower). Mosses, especially *Pleurozium schreberi* (Schreber's big red stem moss), form a nearly continuous carpet (Eyre 1980, Sims et al. 1989).

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MOST ABUNDANT SPECIES

Apostle Islands National Lakeshore

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus banksiana* (jack pine)
Short shrub/sapling	Needle-leaved shrub	*Juniperus communis* (common juniper)
Herb (field)	Dwarf-shrub	*Vaccinium angustifolium* (lowbush blueberry)
Herb (field)	Graminoid	*Deschampsia flexuosa* (wavy hairgrass)
Nonvascular	Moss	*Pleurozium schreberi* (Schreber's big red stem moss)

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Deschampsia flexuosa* (wavy hairgrass), *Gaultheria procumbens* (eastern teaberry), *Juniperus communis* (common juniper), *Pinus banksiana* (jack pine), *Pleurozium schreberi* (Schreber's big red stem moss), *Vaccinium angustifolium* (lowbush blueberry)

OTHER NOTEWORTHY SPECIES

Apostle Islands National Lakeshore: Vulnerable: *Deschampsia flexuosa* (wavy hairgrass, state-vulnerable, G5)

CONSERVATION STATUS RANK

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

CLASSIFICATION

Status: Standard

Classification Confidence: 2 - Moderate

Global Comments: *Pinus banksiana / Arctostaphylos uva-ursi* Forest (CEGL002438) in northwestern Minnesota and southeastern Manitoba appears to be similar to this community, but is on deeper sands. This type also overlaps with *Pinus banksiana - (Pinus resinosa) - Quercus ellipsoidalis / Carex pensylvanica* Forest (CEGL002478), especially in Wisconsin, where timber management can cause a lot of variation in the proportion of oak and pine (E. Epstein pers. comm. 2000).

Global Similar Associations:

- *Pinus banksiana - (Picea mariana, Pinus strobus) / Vaccinium* spp. Rocky Woodland (CEGL002483)
- *Pinus banksiana - (Pinus resinosa) - Quercus ellipsoidalis / Carex pensylvanica* Forest (CEGL002478)--This is the mixed pine-oak type on sands.
- *Pinus banksiana - (Pinus resinosa) / Corylus cornuta* Forest (CEGL002442)
- *Pinus banksiana - (Quercus ellipsoidalis) / Schizachyrium scoparium* - Prairie Forbs Wooded Herbaceous Vegetation (CEGL002490)
- *Pinus banksiana - Pinus resinosa - (Quercus ellipsoidalis) / Carex pensylvanica* Wooded Herbaceous Vegetation (CEGL005124)
- *Pinus banksiana - Pinus resinosa / Quercus ellipsoidalis* Woodland (CEGL002484)
- *Pinus banksiana / Arctostaphylos uva-ursi* Forest (CEGL002438)--This community occurs on deep, sandy lacustrine plains and beach dunes, with a high fire frequency. It is drier and possible on less fertile soils.

Global Related Concepts:

- Dry Northern Forest - Jack Pine (Northern Pin Oak) (Chapman et al. 1989) =
- Jack Pine - Feathermoss (Zoladeski et al. 1995) =
- Jack Pine / Ericaceous Shrub / Feathermoss (V29) (Sims et al. 1989) B
- Jack Pine: 1, Jack pine - Feather moss (subtype b) (Eyre 1980) B
- Oligotrophic Fresh *Arctostaphylos-Linnaea* Type on Low Beta- and Gamma-gley Podzols (Mueller-Dombois 1964) =

ELEMENT DISTRIBUTION

Apostle Islands National Lakeshore Range: This white pine forest occurs near Little Sand Bay on the mainland and on Bear Island.

Global Range: This jack pine forest community is found in the northern parts of the midwestern United States and in central Canada, ranging from northern Michigan and northern Wisconsin west and north to Minnesota, southeastern Manitoba, and northwestern Ontario. Disjunct occurrences are known from western Maine and possibly New York.

Nations: CA, US

States/Provinces: MB:S4S5, ME:S1, MI:S4, MN:S3, NB, NY, ON, QC, WI:S3

TNC Ecoregions: 47:C, 48:C, 63:C

USFS Ecoregions (1994/95): 212Ha:CC?, 212Hb:CCP, 212He:CC?, 212Hh:CC?, 212Hi:CCC, 212Hj:CC?, 212Hk:CC?, 212Hl:CCC, 212Hm:CCP, 212Ho:CCC, 212Hp:CCP, 212Hq:CCP, 212Hr:CCP, 212Hs:CCP, 212Ht:CCP, 212Hv:CCP, 212Hw:CCC, 212Hy:CCC, 212Ia:CCC, 212Ib:CCP, 212Ja:CCP, 212Jc:CCP, 212Jl:CCP, 212Jm:CCC, 212Jn:CCP, 212Jo:CC?, 212Ka:CCC, 212Na:CCC, 212Nb:CCP, 212Nc:CCC, M212Af:CCC, M212D:CP

Federal Lands: NPS (Apostle Islands, Pictured Rocks, Sleeping Bear Dunes); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Hiawatha, Huron, Huron-Manistee, Manistee, Nicolet, Ottawa)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (2 plots): APIS.223, APIS.226.

Apostle Islands National Lakeshore Map Code: FJB

Local Description Authors: M.J. Russo

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Global Description Authors: J. Drake

References: Chapman et al. 1989, Epstein pers. comm., Eyre 1980, Farrand and Bell 1982, Gawler 2002, Greenall 1996, MNNHP 1993, Midwestern Ecology Working Group n.d., Mueller-Dombois 1964, Sims et al. 1989, WNHIP unpubl. data, Zoladeski et al. 1995

G048. White Spruce - Balsam Fir Forest

Balsam Fir - Paper Birch Forest

***Abies balsamea - Betula papyrifera / Diervilla lonicera* Forest**
Balsam Fir - Paper Birch / Northern Bush-honeysuckle Forest
Identifier: CEGL002474

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)	Balsam Fir - Paper Birch Forest
Ecological System(s):	Boreal White Spruce-Fir-Hardwood Forest (CES103.021)

ELEMENT CONCEPT

Global Summary: This balsam fir - birch sub-boreal forest type is found in the northern Great Lakes region of the United States and Canada and elsewhere in central Canada. Stands occur on deep, moist to mesic, mineral soils, usually loams. It can be on flat to moderate slopes and, in northern Minnesota, tends to be near water. Canopy is either pure evergreen or mixed evergreen-deciduous. The overstory is usually dominated by *Abies balsamea* (balsam fir) and *Betula papyrifera* (paper birch) but some stands may have large amounts of *Populus tremuloides* (quaking aspen). Other common trees include *Picea glauca* (white spruce), *Picea mariana* (black spruce), *Pinus strobus* (eastern white pine), and *Thuja occidentalis* (northern white-cedar). *Abies balsamea* (balsam fir) is also abundant in the sapling/shrub stratum, along with *Acer spicatum* (mountain maple), *Betula papyrifera* (paper birch), *Diervilla lonicera* (northern bush honeysuckle), *Corylus cornuta* (beaked hazelnut), *Linnaea borealis* (twinflower), *Rubus pubescens* (dwarf red blackberry), *Sorbus americana* (American mountain-ash), and *Taxus canadensis* (Canada yew) (especially on Isle Royale and in northern Wisconsin). Herbaceous species found in this community include *Anemone quinquefolia* (nightcaps), *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Clintonia borealis* (bluebead), *Coptis trifolia* (threeleaf goldthread), *Cornus canadensis* (bunchberry dogwood), *Maianthemum canadense* (Canada mayflower), *Mitella nuda* (naked miterwort), *Streptopus lanceolatus* var. *longipes* (twistedstalk), and *Trientalis borealis* (starflower). Mosses include *Hylocomium splendens* (splendid feather moss), *Plagiomnium cuspidatum* (toothed plagiomnium moss), *Pleurozium schreberi* (Schreber's big red stem moss), and *Ptilium crista-castrensis* (knights plume moss).

ENVIRONMENTAL DESCRIPTION

Apostle Islands National Lakeshore Environment: This balsam fir - birch sub-boreal forest was sampled at four locations in the park: two sites on Devils Island, one near Sand Point, and one on Sand Island. Sites are on gentle midslope lake terraces and moraines and a step-in-slope bench of variable aspect. It was not sampled but was noted as common as a nearly solid ring around many of the northern islands of APIS. Soils are moderately well- to well-drained loamy sand and sandy loam. The ground surface is dominated by leaf litter (40-70% cover) with some wood (10-15%). Evidence of disturbance includes wind damage (blowdown).
Global Environment: This community is found on deep, moist to mesic, mineral soils, usually loams (Sims et al. 1989). It can be on flat to moderate slopes (5-30%) and, in northern Minnesota, tends to be near water (Ohmann and Ream 1971).

VEGETATION DESCRIPTION

Apostle Islands National Lakeshore Vegetation: Physiognomically, the structure of stands can be quite variable. The open to closed (40-100% cover) tree canopy, 5-35 m tall, is dominated by *Abies balsamea* (balsam fir) and may include lesser amounts of *Pinus strobus* (eastern white pine), *Betula alleghaniensis* (yellow birch), *Betula papyrifera* (paper birch), *Thuja occidentalis* (northern white-cedar), and/or *Tsuga canadensis* (eastern hemlock). The sparse to moderate (20-40%) subcanopy (10-15 m) may include *Thuja occidentalis* (northern white-cedar). The very sparse (5-20%) tall-shrub layer (2-5 m) is made up of saplings of the tree species. The very sparse to moderate (5-50%) short-shrub layer (0.5-1 m) may include *Diervilla lonicera* (northern bush honeysuckle), *Ledum groenlandicum* (bog Labrador-tea), *Lonicera canadensis* (American fly honeysuckle), *Rubus parviflorus* (thimbleberry), *Sorbus decora* (northern mountain-ash), *Taxus canadensis* (Canada yew), and others. *Vaccinium angustifolium* (lowbush blueberry) may form a very sparse (5%) dwarf-shrub layer. The very sparse to moderately dense (5-70%) herbaceous layer is dominated by *Clintonia borealis* (bluebead), *Cornus canadensis* (bunchberry dogwood), *Dryopteris intermedia* (intermediate woodfern), *Pteridium aquilinum* (western brackenfern), and *Trientalis borealis* (starflower). Nonvascular species (mosses), including *Pleurozium schreberi* (Schreber's big red stem moss) and *Sphagnum* (sphagnum) sp., cover 5-60% of the ground surface. In addition, this community supports state-critically imperiled *Poa sylvestris* (woodland bluegrass) and state-imperiled *Goodyera oblongifolia* (western rattlesnake plantain).
Global Vegetation: The tree canopy is either pure evergreen or mixed evergreen-deciduous. The overstory is usually dominated by *Abies balsamea* (balsam fir) and *Betula papyrifera* (paper birch), but some stands may have large amounts of *Populus tremuloides* (quaking aspen). Other common trees include *Picea glauca* (white spruce), *Picea mariana* (black spruce), *Pinus strobus* (eastern white pine), and *Thuja occidentalis* (northern white-cedar). Canopy trees may typically be 15-25 m tall (Hansen et al. 1973). *Abies balsamea* (balsam fir) is also abundant in the sapling/shrub stratum, along with *Acer spicatum* (mountain maple), *Betula papyrifera* (paper

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birch), *Diervilla lonicera* (northern bush honeysuckle), *Corylus cornuta* (beaked hazelnut), *Linnaea borealis* (twinflower), *Rubus pubescens* (dwarf red blackberry), *Sorbus americana* (American mountain-ash), and *Taxus canadensis* (Canada yew) (especially on Isle Royale and in northern Wisconsin). Herbaceous species found in this community include *Anemone quinquefolia* (nightcaps), *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Clintonia borealis* (bluebead), *Coptis trifolia* (threeleaf goldthread), *Cornus canadensis* (bunchberry dogwood), *Maianthemum canadense* (Canada mayflower), *Mitella nuda* (naked miterwort), *Streptopus lanceolatus* (twistedstalk), and *Trientalis borealis* (starflower). Mosses include *Hylocomium splendens* (splendid feather moss), *Plagiomnium cuspidatum* (toothed plagiomnium moss), *Pleurozium schreberi* (Schreber's big red stem moss), and *Ptilium crista-castrensis* (knights plume moss) (Sims et al. 1989).

MOST ABUNDANT SPECIES

Apostle Islands National Lakeshore

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Abies balsamea* (balsam fir)
Tree canopy	Broad-leaved deciduous tree	*Betula alleghaniensis* (yellow birch), *Betula papyrifera* (paper birch)
Short shrub/sapling	Broad-leaved deciduous shrub	*Diervilla lonicera* (northern bush honeysuckle)
Herb (field)	Forb	*Clintonia borealis* (bluebead)

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Abies balsamea* (balsam fir), *Betula alleghaniensis* (yellow birch), *Betula papyrifera* (paper birch), *Clintonia borealis* (bluebead), *Cornus canadensis* (bunchberry dogwood), *Diervilla lonicera* (northern bush honeysuckle), *Dryopteris intermedia* (intermediate woodfern), *Pleurozium schreberi* (Schreber's big red stem moss), *Pteridium aquilinum* (western brackenfern), *Thuja occidentalis* (northern white-cedar)

OTHER NOTEWORTHY SPECIES

Apostle Islands National Lakeshore: Vulnerable: *Goodyera oblongifolia* (western rattlesnake plantain, state-imperiled, G5?), *Poa sylvestris* (woodland bluegrass, state-critically imperiled, G5); **Exotic/Invasive**: *Phleum pratense* (timothy, exotic, Medium)

CONSERVATION STATUS RANK

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

CLASSIFICATION

Status: Standard

Classification Confidence: 2 - Moderate

Global Comments: This type does not always have a pure evergreen canopy; it can grade into mixed evergreen-deciduous canopy in northern and central Ontario. It intergrades heavily with spruce-fir evergreen types, *Picea glauca - Abies balsamea / Acer spicatum / Rubus pubescens* Forest (CEGL002446), and spruce-fir-hardwood mixed evergreen-deciduous types, *Picea glauca - Abies balsamea - Populus tremuloides* / Mixed Herbs Forest (CEGL002475), and could perhaps be lumped with either of these two types. Sims et al. (1989) note that this type (their V14) is often uneven-aged with relatively closed canopies, and occurs less frequently on calcareous soils. In Manitoba this type can be common following insect infestation by spruce budworm or tree harvesting without replanting (J. Greenall pers. comm. 1999).

Global Similar Associations:

- *Picea glauca - Abies balsamea - Populus tremuloides* / Mixed Herbs Forest (CEGL002475)
- *Picea glauca - Abies balsamea / Acer spicatum / Rubus pubescens* Forest (CEGL002446)

Global Related Concepts:

- Balsam Fir - Yellow Birch - Paper Birch - White Spruce (Hansen et al. 1973) I
- Balsam Fir Mixedwood (V14) (Sims et al. 1989) =
- Fir - Birch (Ohmann and Ream 1971) =
- Fir - Birch - *Mitella* (Kurmis et al. 1986) B

ELEMENT DISTRIBUTION

Apostle Islands National Lakeshore Range: This balsam fir - birch forest is found on Devils Island, near Sand Point, and on Sand Island.

Global Range: This balsam fir - birch sub-boreal forest type is found in the northern Great Lakes region of the United States and Canada and elsewhere in central Canada, ranging from northern Minnesota and Manitoba east to Ontario.

Nations: CA, US

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

TNC Ecoregions: 47:C, 48:C

USFS Ecoregions (1994/95): 212Hi:CCC, 212Ia:CCC, 212Ib:CC?, 212Jl:C??, 212La:CCP, 212Lb:CC?, 212Lc:CCP, 212Ld:CC?, 212Mb:CPP, 212Na:CPP, 212Nb:CPP, 212Nc:CPP

Federal Lands: NPS (Apostle Islands, Pictured Rocks, Voyageurs); USFS (Chequamegon-Nicolet?, Chequamegon?, Chippewa, Nicolet?, Superior)

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ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (4 plots): APIS.034, APIS.130, APIS.215, APIS.216.
Apostle Islands National Lakeshore Map Code: FBF, FFB
Local Description Authors: M.J. Russo
Global Description Authors: J. Drake, mod. D. Faber-Langendoen 06-00
References: Greenall 1996, Hansen et al. 1973, Kurmis et al. 1986, MNNHP 1993, Midwestern Ecology Working Group n.d., Ohmann and Ream 1971, Sims et al. 1989

Paper Birch / Fir Forest

***Betula papyrifera / Diervilla lonicera - (Abies balsamea)* Forest**
Paper Birch / Northern Bush-honeysuckle - (Balsam Fir) Forest
Identifier: CEGL002463

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)	Paper Birch / Fir Forest

ELEMENT CONCEPT

Global Summary: This paper birch forest is found in the northern Great Lakes region of the United States and perhaps more widely in Canada. Stands occur on fresh to moist soils, coarse-textured, non-calcareous mineral soils. The soil texture is typically coarse loam. The canopy of this forested community is closed to moderately open. *Betula papyrifera* (paper birch) is the dominant canopy tree and can form nearly pure stands. *Populus tremuloides* (quaking aspen), *Abies balsamea* (balsam fir), *Picea glauca* (white spruce), and, especially in Canada, *Pinus banksiana* (jack pine) can also be found. Tree density can be high, but the growth form and size of the canopy dominants allow significant light to pass through. *Abies balsamea* (balsam fir) is common to dense in the understory as are shrubs such as *Corylus cornuta* (beaked hazelnut), *Diervilla lonicera* (northern bush honeysuckle), *Rosa acicularis* (prickly rose), and *Taxus canadensis* (Canada yew). The herbaceous layer is similar to other dry-mesic to mesic northern communities. Species found in this layer include *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Clintonia borealis* (bluebead), *Cornus canadensis* (bunchberry dogwood), *Maianthemum canadense* (Canada mayflower), and *Trientalis borealis* (starflower).

ENVIRONMENTAL DESCRIPTION

Apostle Islands National Lakeshore Environment: This paper birch forest was sampled only once in the park at the western end of the mainland unit. The site is on a moderate west-facing midslope at 223 m (730 feet) elevation. The soil is a moderately well-drained loamy sand. The unvegetated surface is dominated by leaf litter (95% cover) with some wood (5%). Evidence of disturbance includes possible past fire resulting in a nearly pure stand of birch.
Global Environment: This community is found on fresh to moist soils (Hansen et al. 1973, Sims et al. 1989). In Ontario, it occurs on coarse-textured, non-calcareous mineral soils. The soil texture is typically coarse loam (Sims et al. 1989).

VEGETATION DESCRIPTION

Apostle Islands National Lakeshore Vegetation: The moderate (50% cover) tree canopy, 20-35 m tall, is dominated solely by *Betula papyrifera* (paper birch). The sparse (10%) subcanopy (15-20 m) includes *Abies balsamea* (balsam fir) and *Acer rubrum* (red maple). The sparse (10%) tall-shrub layer (2-5 m) contains *Abies balsamea* (balsam fir) and *Acer spicatum* (mountain maple). The sparse (20%) short-shrub layer (0.5-1 m) is dominated by *Lonicera canadensis* (American fly honeysuckle). The dense herbaceous layer (90%) is dominated by *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), and *Pteridium aquilinum* (western brackenfern) with lesser amounts of *Carex* (sedge) spp., *Clintonia borealis* (bluebead), *Cornus canadensis* (bunchberry dogwood), *Equisetum arvense* (field horsetail), *Gymnocarpium dryopteris* (western oakfern), *Lycopodium* (clubmoss) spp., *Maianthemum canadense* (Canada mayflower), *Melampyrum lineare* (narrowleaf cowwheat), *Phegopteris connectilis* (long beechfern), and *Trientalis borealis* (starflower).
Global Vegetation: The canopy of this forested community is closed to moderately open. *Betula papyrifera* (paper birch) is the dominant canopy tree and can form nearly pure stands. *Populus tremuloides* (quaking aspen), *Abies balsamea* (balsam fir), *Picea glauca* (white spruce), and, especially in Canada, *Pinus banksiana* (jack pine) can be found in minor amounts, as well. Tree density can be high, but the growth form and size of the canopy dominants allows significant light to pass through. *Abies balsamea* (balsam fir) is common to dense in the understory (Hansen et al. 1973) along with shrubs such as *Corylus cornuta* (beaked hazelnut), *Diervilla lonicera* (northern bush honeysuckle), *Rosa acicularis* (prickly rose), and *Taxus canadensis* (Canada yew). The herbaceous layer is similar to other dry-mesic to mesic northern communities. Species found in this layer include *Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster), *Clintonia borealis* (bluebead), *Cornus canadensis* (bunchberry dogwood), *Maianthemum canadense* (Canada mayflower), and *Trientalis borealis* (starflower).

MOST ABUNDANT SPECIES

Apostle Islands National Lakeshore

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Betula papyrifera* (paper birch)

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Herb (field)	Forb	*Aralia nudicaulis* (wild sarsaparilla), *Eurybia macrophylla* (bigleaf aster)
Herb (field)	Fern or fern ally	*Pteridium aquilinum* (western brackenfern)

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Acer spicatum* (mountain maple), *Aralia nudicaulis* (wild sarsaparilla), *Betula papyrifera* (paper birch), *Diervilla lonicera* (northern bush honeysuckle), *Eurybia macrophylla* (bigleaf aster), *Pteridium aquilinum* (western brackenfern)

CONSERVATION STATUS RANK

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

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Global Comments: *Clintonia borealis* (bluebead), *Lycopodium annotinum* (stiff clubmoss), and mosses may be more common in this community while *Eurybia macrophylla* (bigleaf aster) may be more common in other early successional community types dominated by *Populus tremuloides* (quaking aspen) (MNNHP 1993). Stands should usually have >90% of their deciduous canopy composed of *Betula papyrifera* (paper birch) to be included in this community. Manitoba is not sure this type forms significant stands in that province (J. Greenall pers. comm. 1999). Some authors treat this type as synonymous with the aspen-paper birch type *Populus tremuloides - Betula papyrifera / (Abies balsamea, Picea glauca)* Forest (CEGL002466) (K. Rusterholz pers. comm. 2000).
Global Similar Associations:
- *Betula papyrifera / Acer saccharum* - Mixed Hardwoods Forest (CEGL002464)
- *Populus tremuloides - Betula papyrifera / (Abies balsamea, Picea glauca)* Forest (CEGL002466)

Global Related Concepts:
- Paper Birch - Aspen - White Spruce (1936) (Hansen et al. 1973) =
- White Birch Hardwood and Mixedwood (V4) (Sims et al. 1989) =

ELEMENT DISTRIBUTION

Apostle Islands National Lakeshore Range: This paper birch forest was sampled at the western end of the mainland unit.
Global Range: This paper birch forest type is found in the northern Great Lakes region of the United States and perhaps more widely in Canada, ranging from Minnesota and Manitoba east to Ontario and possibly Quebec.
Nations: CA, US
States/Provinces: MB:S3S4, MI, MN:S4?, ON, QC:S4?, WI
TNC Ecoregions: 47:C, 48:C
USFS Ecoregions (1994/95): 212Hi:CCC, 212Ia:CCC, 212Ib:CCC, 212La:CPP, 212Mb:CPP, 212Na:CPP, 212Nb:CPP, 212Nc:CPP
Federal Lands: NPS (Apostle Islands, Isle Royale, Pictured Rocks, Voyageurs); USFS (Chippewa, Superior?)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (1 plot): APIS.300.
Apostle Islands National Lakeshore Map Code: FPB
Local Description Authors: M.J. Russo
Global Description Authors: J. Drake
References: Greenall 1996, Hansen et al. 1973, MNNHP 1993, Midwestern Ecology Working Group n.d., Sims et al. 1989

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
Ecological System(s):	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,

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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

Apostle Islands National Lakeshore Environment: This aspen - birch forest was sampled once on Oak Island. The site is a gentle west-facing moraine step-in-slope with well-drained loamy sand soils. The ground surface is dominated by leaf litter (75% cover) with some wood (8-15%) and dead plant stems (10%). 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

Apostle Islands National Lakeshore Vegetation: The moderate (60% cover) tree canopy, 20-35 m tall, is made up of *Betula papyrifera* (paper birch), *Populus grandidentata* (bigtooth aspen), and *Tsuga canadensis* (eastern hemlock). The moderate (40%) subcanopy (15-20 m) is comprised of *Acer saccharum* (sugar maple), *Abies balsamea* (balsam fir), and *Acer rubrum* (red maple), as is the moderate (50%) tall-shrub layer (2-5 m) along with *Corylus cornuta* (beaked hazelnut). The very sparse (<5%) short-shrub layer (1-2 m) includes *Amelanchier* (serviceberry) sp. and *Lonicera canadensis* (American fly honeysuckle). The very sparse (5%) herbaceous layer is made up of tree seedlings as well as *Aralia nudicaulis* (wild sarsaparilla), *Lycopodium annotinum* (stiff clubmoss), *Lycopodium dendroideum* (tree groundpine), *Maianthemum canadense* (Canada mayflower), *Monotropa uniflora* (Indianpipe), and *Trientalis borealis* (starflower).

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

Apostle Islands National Lakeshore

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Tsuga canadensis* (eastern hemlock)
Tree canopy	Broad-leaved deciduous tree	*Betula papyrifera* (paper birch), *Populus grandidentata* (bigtooth aspen)
Tree subcanopy	Broad-leaved deciduous tree	*Acer saccharum* (sugar maple)
Tall shrub/sapling	Needle-leaved shrub	*Abies balsamea* (balsam fir)

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Abies balsamea* (balsam fir), *Acer saccharum* (sugar maple), *Betula papyrifera* (paper birch), *Lycopodium dendroideum* (tree groundpine), *Maianthemum canadense* (Canada mayflower), *Populus grandidentata* (bigtooth aspen), *Trientalis borealis* (starflower), *Tsuga canadensis* (eastern hemlock)

CONSERVATION STATUS RANK

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

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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

Apostle Islands National Lakeshore Range: This aspen - birch forest was sampled on Oak Island.
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)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (1 plot): APIS.032.
Apostle Islands National Lakeshore 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

1.D.2. Boreal Flooded & Swamp Forest

1.D.2.a. North American Boreal Flooded & Swamp Forest

MG038. Central & Eastern Boreal Flooded & Swamp Forest

G050. Black Spruce - Tamarack Acidic Swamp

Black Spruce - Tamarack / Labrador-tea Poor Swamp

***Picea mariana - (Larix laricina) / Ledum groenlandicum / Sphagnum* spp. Forest**
Black Spruce - (Tamarack) / Bog Labrador-tea / Peatmoss species Forest
Identifier: CEGL005271

NVC CLASSIFICATION

Division	North American Boreal Flooded & Swamp Forest (1.D.2.a)
Macrogroup	Central & Eastern Boreal Flooded & Swamp Forest (MG038)
Group	Black Spruce - Tamarack Acidic Swamp (G050)
Association (Common name)	Black Spruce - Tamarack / Labrador-tea Poor Swamp
Ecological System(s):	Boreal-Laurentian Conifer Acidic Swamp (CES103.724)

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Boreal-Laurentian Bog (CES103.581)

ELEMENT CONCEPT

Global Summary: This community is found in the northern Great Lakes and Northern Appalachian/Boreal region of the United States and Canada and elsewhere in the boreal regions of central and eastern Canada. Sites are found on level, wet sites with organic soils, but not generally as components of large open peatlands. These sites are poorly drained and acidic, allowing a moderate to thick layer of peat to accumulate. Nutrient levels are very low. The overstory of this community is dominated by conifers. The tree canopy is closed to broken to closed with a moderately well-developed low-shrub layer, sparse herbaceous layer, and a carpet of mosses. The canopy is often pure *Picea mariana* (black spruce). The only other trees that are occasionally found with it are *Abies balsamea* (balsam fir), *Larix laricina* (tamarack), and *Pinus banksiana* (jack pine). The shrubs are primarily ericaceous and include *Chamaedaphne calyculata* (leatherleaf), *Gaultheria hispidula* (creeping snowberry), *Kalmia polifolia* (bog laurel), *Ledum groenlandicum* (bog Labrador-tea), and *Vaccinium myrtilloides* (velvetleaf huckleberry), as well as *Cornus canadensis* (bunchberry dogwood). In the Northeast, shrubs may include *Kalmia angustifolia* (sheep laurel), *Nemopanthus mucronatus* (catberry), *Viburnum nudum* var. *cassinoides* (withe-rod), or *Rhododendron canadense* (rhodora). The few herbaceous species that live in this community include *Carex trisperma* (threeseeded sedge), *Eriophorum vaginatum* var. *spissum* (tussock cottongrass), *Clintonia borealis* (bluebead), and *Maianthemum trifolium* (threeleaf false lily of the valley). *Sphagnum* (sphagnum) spp., *Dicranum polysetum* (dicranum moss), and *Pleurozium schreberi* (Schreber's big red stem moss) are the major species constituting the abundant moss layer.

ENVIRONMENTAL DESCRIPTION

Apostle Islands National Lakeshore Environment: This black spruce swamp forest was sampled at three locations on Sand Island, three locations on Stockton Island and one location on Bear Island. Sites are mostly flat depressions; the Bear Island site is in a gently sloping, northeast-facing depression. These depressions are seasonally flooded and have poorly drained peat or muck soils, with hummock-and-hollow microtopography. Elevations range from 180 to 260 m (593-843 feet). The unvegetated surface is made up of leaf litter (0-98% cover) with some wood (0-50%).; two of the sampled plots have no unvegetated surface. There is some evidence of deer trails in the area and fungal growth on the black spruce.

Global Environment: This community is found on level, wet sites with organic soils (Zoladeski et al. 1995). These sites are poorly to very poorly drained and acidic, allowing a moderate to thick layer of peat to accumulate. Nutrient levels are very low (Kurmis et al. 1986).

VEGETATION DESCRIPTION

Apostle Islands National Lakeshore Vegetation: The sparse to moderate (20-50% cover) tree canopy, 5-35 m tall, is dominated by *Larix laricina* (tamarack), *Pinus strobus* (eastern white pine) and/or *Picea mariana* (black spruce). The sparse to moderate (10-50%) subcanopy (5-15 m) includes *Betula alleghaniensis* (yellow birch), *Betula papyrifera* (paper birch), and *Pinus strobus* (eastern white pine). The sparse to moderately dense (10-70%) tall-shrub layer (2-5 m) includes canopy and subcanopy species along with possible *Alnus incana* (gray alder) and *Larix laricina* (tamarack). The sparse to very dense (30-90%) short-shrub layer (0.5-1 m) is dominated by *Ledum groenlandicum* (bog Labrador-tea) along with lesser amounts of *Nemopanthus mucronatus* (catberry) and *Vaccinium myrtilloides* (velvetleaf huckleberry). *Chamaedaphne calyculata* (leatherleaf), *Kalmia polifolia* (bog laurel), *Vaccinium angustifolium* (lowbush blueberry), and *Vaccinium oxycoccos* (small cranberry) form a very sparse to moderately dense (5-70%) dwarf-shrub layer (<0.5 m). The very sparse to moderate herbaceous layer (5-40%) is dominated by *Carex trisperma* (threeseeded sedge), *Carex utriculata* (Northwest Territory sedge), *Carex oligosperma* (fewseed sedge), *Gaultheria hispidula* (creeping snowberry), and/or *Maianthemum trifolium* (threeleaf false lily of the valley) and may include lesser amounts of tree seedlings, *Calamagrostis canadensis* (bluejoint), *Carex lacustris* (hairy sedge), *Eriophorum virginicum* (tawny cottongrass), *Eriophorum vaginatum* var. *spissum* (tussock cottongrass), *Melampyrum lineare* (narrowleaf cowwheat), and/or *Osmunda cinnamomea* (cinnamon fern). The ground surface has a nearly continuous cover (90-100%) of nonvascular species (mosses) mostly *Sphagnum* (sphagnum) spp. and some *Pleurozium schreberi* (Schreber's big red stem moss).

Global Vegetation: The overstory of this community is dominated by conifers. The tree canopy is closed to broken to closed with a moderately well-developed low-shrub layer, sparse herbaceous layer, and a carpet of mosses (Kurmis et al. 1986). The canopy is often pure *Picea mariana* (black spruce). *Abies balsamea* (balsam fir) can be present as a codominant. The only other trees that are occasionally found with it are *Larix laricina* (tamarack) and *Pinus banksiana* (jack pine) (Sims et al. 1989). The shrubs are primarily ericaceous and include *Chamaedaphne calyculata* (leatherleaf), *Gaultheria hispidula* (creeping snowberry), *Kalmia polifolia* (bog laurel), *Ledum groenlandicum* (bog Labrador-tea), and *Vaccinium* (blueberry) spp., as well as *Cornus canadensis* (bunchberry dogwood). In the Northeast, shrubs may include *Kalmia angustifolia* (sheep laurel), *Nemopanthus mucronatus* (catberry), *Viburnum nudum* var. *cassinoides* (withe-rod), or *Rhododendron canadense* (rhodora). The few herbaceous species that live in this community include *Carex lasiocarpa* (woollyfruit sedge), *Carex trisperma* (threeseeded sedge), *Eriophorum vaginatum* var. *spissum* (tussock cottongrass), *Clintonia borealis* (bluebead), *Coptis trifolia* (threeleaf goldthread), and *Maianthemum trifolium* (threeleaf false lily of the valley). *Dicranum polysetum* (dicranum moss), *Sphagnum* (sphagnum) spp., and *Pleurozium schreberi* (Schreber's big red stem moss) are the major species constituting the abundant moss layer (Damman and French 1987, Sims et al. 1989, Harris et al. 1996). Localized minerotrophic areas may contain a more diverse herbaceous layer, including species such as *Osmunda cinnamomea* (cinnamon fern).

MOST ABUNDANT SPECIES

Apostle Islands National Lakeshore

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Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Larix laricina* (tamarack), *Picea mariana* (black spruce), *Pinus strobus* (eastern white pine)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Alnus incana* (gray alder)
Short shrub/sapling	Broad-leaved evergreen shrub	*Ledum groenlandicum* (bog Labrador-tea)
Herb (field)	Dwarf-shrub	*Chamaedaphne calyculata* (leatherleaf)

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Alnus incana* (gray alder), *Betula papyrifera* (paper birch), *Carex trisperma* (threeseeded sedge), *Carex utriculata* (Northwest Territory sedge), *Chamaedaphne calyculata* (leatherleaf), *Gaultheria hispidula* (creeping snowberry), *Kalmia polifolia* (bog laurel), *Larix laricina* (tamarack), *Ledum groenlandicum* (bog Labrador-tea), *Maianthemum trifolium* (threeleaf false lily of the valley), *Picea mariana* (black spruce), *Pinus strobus* (eastern white pine), *Pleurozium schreberi* (Schreber's big red stem moss), *Vaccinium myrtilloides* (velvetleaf huckleberry), *Vaccinium oxycoccos* (small cranberry)

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (27-Jun-2000).

CLASSIFICATION

Status: Standard

Classification Confidence: 2 - Moderate

Global Comments: This type represents poor black spruce swamps in closed peatland basins. Conceptually, it overlaps with black spruce bog forests, *Picea mariana / Ledum groenlandicum / Carex trisperma / Sphagnum* spp. Forest (CEGL002485), which are more typically found in open peatland complexes. This type is found in smaller basins, where a weakly minerotrophic influence is more likely. In the Northern Appalachian/Boreal ecoregion, *Abies balsamea* (balsam fir) differentiates this type from bogs of lower elevations and latitudes. Stands in northeast U.S. and Canada may also contain a suite of shrub species, such as *Kalmia angustifolia* (sheep laurel), *Nemopanthus mucronatus* (catberry), *Viburnum nudum* var. *cassinoides* (withe-rod), or *Rhododendron canadense* (rhodora). These species differ from those in the midwestern U.S. and central Canada, but their constancy in this type needs further evaluation.

Global Similar Associations:

- *Larix laricina / Alnus incana* Forest (CEGL002471)
- *Picea mariana / (Vaccinium corymbosum, Gaylussacia baccata) / Sphagnum* sp. Woodland (CEGL006098)
- *Picea mariana / Alnus incana / Sphagnum* spp. Forest (CEGL002452)--is similar but tends to have a greater diversity and coverage of herbs and to be more nutrient-rich.
- *Picea mariana / Ledum groenlandicum / Carex trisperma / Sphagnum* spp. Forest (CEGL002485)--overlaps.
- *Picea mariana / Pleurozium schreberi* Forest (CEGL002447)
- *Pinus banksiana - (Picea mariana)* - Mixed Hardwoods / *Sphagnum* spp. Forest (CEGL005166)
- *Populus tremuloides - (Populus grandidentata)* Rocky Woodland (CEGL002487)
- *Thuja occidentalis - Larix laricina / Sphagnum* spp. Forest (CEGL005225)

Global Related Concepts:

- *Carex trisperma* - Black spruce forest (Damman and French 1987) =
- *Habenario - Picetum* Association (Janssen 1967) =
- Black Spruce - *Kalmia* Type (Kurmis et al. 1986) =
- Black Spruce / Bunchberry / Sphagnum (Feathermoss) (V36) (Sims et al. 1989) F
- Black Spruce / Ericaceous Shrub / Sphagnum (V37) (Sims et al. 1989) F
- Black Spruce / Herb Poor / Sphagnum (Feathermoss) (Zoladeski et al. 1995) =
- Black Spruce / Labrador Tea / Feathermoss (Sphagnum) (V34) (Sims et al. 1989) F
- Black Spruce Bog (Woodland) (Thompson 1996) ?
- Black Spruce: 12 (Eyre 1980) B
- Palustrine Scrub-Shrub Needle-leaved Evergreen Saturated Wetland (PSS4B) (Cowardin et al. 1979) ?
- Poor Conifer Swamp - Black Spruce (Tamarack) Swamp (Chapman et al. 1989) =
- Poor conifer swamp: black spruce / Labrador Tea / Sphagnum (W27) (Harris et al. 1996) F
- Poor conifer swamp: black spruce / Labrador Tea / bluejoint grass (W28) (Harris et al. 1996) F
- Spring-fen forest (Glaser 1992b) =

ELEMENT DISTRIBUTION

Apostle Islands National Lakeshore Range: This black spruce swamp forest occurs on Sand Island, Stockton Island and Bear Island.

Global Range: This community is found in the northern Great Lakes region and Northern Appalachian-Acadian region of the United States and Canada and elsewhere in the boreal regions of central Canada. It ranges from northern Michigan to northern Minnesota, and northward to parts of Manitoba, Ontario, Quebec, and the Atlantic Provinces.

Nations: CA, US

States/Provinces: MB:S5, ME, MI:S4, MN, NB, NH, NY, ON, PA, QC:S4, VT:S2, WI:S3S4

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

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USFS Ecoregions (1994/95): 212Aa:CCC, 212Ab:CCC, 212Ba:CCC, 212Bb:CCC, 212Ca:CCC, 212Cb:CCC, 212Da:CCC, 212Dc:CCC, 212Ha:CCP, 212Hb:CCP, 212He:CCP, 212Hh:CCP, 212Hi:CCC, 212Hj:CCC, 212Hk:CCP, 212Ho:CCC, 212Hp:CCP, 212Hq:CCC, 212Hr:CCP, 212Hs:CCP, 212Hv:CCP, 212Hw:CCC, 212Ia:CCC, 212Ib:CCC, 212Ja:CPP, 212Jb:CPP, 212Jc:CPP, 212Je:CPP, 212Jf:CPP, 212Jj:CPP, 212Jk:CPP, 212Jl:CPP, 212Jm:CPP, 212Jn:CPP, 212Jo:CPP, 212Jr:CPP, 212Ka:CCP, 212Kb:CCC, 212La:CCC, 212Lb:CCC, 212Lc:CCC, 212Ld:CCC, 212Ma:CCC, 212Mb:CCC, 212Na:CCC, 212Nb:CCC, 212Nc:CCC, 221Ag:CCC, 221Ah:CCC, 221Ai:CCC, 221Ak:CCC, 221Al:CCC, M212Aa:CCC, M212Ab:CCC, M212Ac:CCC, M212Ad:CCC, M212Ae:CCC, M212Af:CCC, M212Ag:CCC, M212Ba:CCC, M212Ca:CCC, M212Cd:CCC, M212Da:CCC, M212Db:CCC, M212Dc:CCC, M212Dd:CCP
Federal Lands: NPS (Acadia, Apostle Islands, Isle Royale, Pictured Rocks, Saint Croix, Sleeping Bear Dunes, Voyageurs); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Hiawatha?, Huron, Huron-Manistee, Manistee, Nicolet, Ottawa, Superior)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (7 plots): APIS.106, APIS.107, APIS.120, APIS.121, APIS.129, APIS.137, APIS.403.
Apostle Islands National Lakeshore Map Code: FSS, FTP
Local Description Authors: M.J. Russo
Global Description Authors: D. Faber-Langendoen
References: Anderson and Davis 1997, Chapman et al. 1989, Cowardin et al. 1979, Damman and French 1987, Edinger et al. 2002, Eyre 1980, Farrand and Bell 1982, Fike 1999, Gawler 2002, Glaser 1992b, Harris et al. 1996, Janssen 1967, Kurmis et al. 1986, MNNHP 1993, Midwestern Ecology Working Group n.d., Sims et al. 1989, Sperduto 2000b, Thompson 1996, Thompson and Sorenson 2000, WNHIP unpubl. data, Zoladeski et al. 1995

G051. Tamarack - Conifer Alkaline Swamp

Northern Tamarack Rich Swamp

***Larix laricina / Alnus incana* Forest**
Tamarack / Gray Alder Forest
Identifier: CEGL002471

NVC CLASSIFICATION

Division	North American Boreal Flooded & Swamp Forest (1.D.2.a)
Macrogroup	Central & Eastern Boreal Flooded & Swamp Forest (MG038)
Group	Tamarack - Conifer Alkaline Swamp (G051)
Association (Common name)	Northern Tamarack Rich Swamp
Ecological System(s):	Laurentian-Acadian Alkaline Conifer-Hardwood Swamp (CES201.575)

ELEMENT CONCEPT

Global Summary: This rich to moderately poor tamarack swamp community is found in the northern Great Lakes region of the United States and Canada. Stands are found on the shores of lakes and rivers above the flooding level, as well as margins of flowage areas of peatland complexes. The substrate is primarily a well-decomposed woody peat in wet, saturated soils, but can also be a moist mineral soil. The canopy layer varies from closed (60-100% cover) to open (25-60% cover), and varies from 3-10 m in height. *Larix laricina* (tamarack) is the dominant tree species, with associates of *Picea mariana* (black spruce) and *Thuja occidentalis* (northern white-cedar). The shrub, herb and moss layers can be very rich to somewhat poor. The shrub layer typically contains *Alnus incana* (gray alder), along with *Abies balsamea* (balsam fir), *Cornus sericea* (red-osier dogwood), *Rhamnus alnifolia* (alderleaf buckthorn), and *Picea mariana* (black spruce). The dwarf-shrub layer is strongly ericaceous, including *Ledum groenlandicum* (bog Labrador-tea) and *Gaultheria hispidula* (creeping snowberry). Other dwarf-shrubs include *Cornus canadensis* (bunchberry dogwood), *Linnaea borealis* (twinflower), *Lonicera villosa* (mountain fly honeysuckle), *Ribes triste* (red currant), *Rosa acicularis* (prickly rose), and *Rubus pubescens* (dwarf red blackberry). Herbaceous species include *Carex disperma* (softleaf sedge), *Carex aquatilis* (water sedge), *Coptis trifolia* (threeleaf goldthread), *Equisetum sylvaticum* (woodland horsetail), *Galium triflorum* (fragrant bedstraw), *Maianthemum canadense* (Canada mayflower), *Maianthemum trifolium* (threeleaf false lily of the valley), *Mitella nuda* (naked miterwort), *Trientalis borealis* (starflower), and *Viola renifolia* (white violet). The moss layer, which is sometimes patchy, includes *Dicranum polysetum* (dicranum moss), *Hylocomium splendens* (splendid feather moss), *Pleurozium schreberi* (Schreber's big red stem moss), *Ptilium crista-castrensis* (knights plume moss), *Rhytidiadelphus triquetrus* (rough goose neck moss), *Sphagnum capillifolium* (sphagnum), and *Sphagnum girgensohnii* (Girgensohn's sphagnum). Diagnostic characteristics include the dominance of *Larix laricina* (tamarack), presence of both minerotrophic shrubs (*Alnus incana* (gray alder), *Cornus sericea* (red-osier dogwood)) and some ericaceous shrubs (e.g., *Ledum groenlandicum* (bog Labrador-tea)), and the incomplete moss layer.

ENVIRONMENTAL DESCRIPTION

Apostle Islands National Lakeshore Environment: This tamarack swamp forest was sampled once on the mainland unit at Little Sand Bay Bog and once near the campsite at East Bay. The sites flat depressions with hummock-and-hollow microtopography. Soils poorly drained peat. The unvegetated surface is made up of leaf litter (2-75% cover) with some wood (2-25%) and dead plant stems (0-25%). No evidence of disturbance was reported.

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Global Environment: Stands are found on the shores of lakes and rivers above the flooding level, as well as margins of flowage areas of peatland complexes. The substrate is primarily a well-decomposed woody peat in wet, saturated soils, but can also be a moist mineral soil (Sims et al. 1989, MNNHP 1993, Harris et al. 1996).

VEGETATION DESCRIPTION

Apostle Islands National Lakeshore Vegetation: The general appearance of this community is of a shrubland with a sparse (30% cover) emergent (10-20 m tall) tree canopy of *Larix laricina* (tamarack). The sparse (5-30%) tall-shrub layer (2-5 m) may include *Alnus incana* ssp. *rugosa* (speckled alder), *Betula papyrifera* (paper birch), *Ilex verticillata* (common winterberry), and *Picea mariana* (black spruce). The moderate to very dense (60-90%) short-shrub layer (0.5-1 m) is dominated by *Myrica gale* (sweetgale) or *Ledum groenlandicum* (bog Labrador-tea) and may include *Chamaedaphne calyculata* (leatherleaf), *Cornus sericea* (red-osier dogwood), and *Vaccinium myrtilloides* (velvetleaf huckleberry). *Andromeda polifolia* var. *glaucophylla* (bog rosemary), *Kalmia polifolia* (bog laurel), and *Vaccinium oxycoccos* (small cranberry) may form a sparse (5-10%) dwarf-shrub layer (<0.5 m). The moderately sparse (30-40%) herbaceous layer includes *Calamagrostis canadensis* (bluejoint), *Carex lasiocarpa* (woollyfruit sedge), *Carex trisperma* (threeseeded sedge), *Equisetum fluviatile* (water horsetail), *Gaultheria hispidula* (creeping snowberry), *Maianthemum trifolium* (threeleaf false lily of the valley), *Menyanthes trifoliata* (buckbean), and *Typha latifolia* (broadleaf cattail). The ground surface has a nearly continuous cover (90%) of nonvascular species (mosses) mostly *Sphagnum* (sphagnum) spp., including *Sphagnum centrale* (sphagnum), *Sphagnum fuscum* (sphagnum), *Sphagnum papillosum* (papillose sphagnum), and possibly others.

Global Vegetation: The canopy layer varies from closed (60-100% cover) to open (25-60% cover), and may also range from 3-10 m in height. *Larix laricina* (tamarack) is the dominant tree species, with associates of *Picea mariana* (black spruce) and *Thuja occidentalis* (northern white-cedar). The shrub, herb and moss layers can be very rich to somewhat poor. The shrub layer typically contains *Alnus incana* (gray alder), along with *Abies balsamea* (balsam fir), *Cornus sericea* (red-osier dogwood), *Rhamnus alnifolia* (alderleaf buckthorn), and *Picea mariana* (black spruce). The dwarf-shrub layer is strongly ericaceous, including *Ledum groenlandicum* (bog Labrador-tea) and *Gaultheria hispidula* (creeping snowberry). Other dwarf-shrubs include *Cornus canadensis* (bunchberry dogwood), *Linnaea borealis* (twinflower), *Lonicera villosa* (mountain fly honeysuckle), *Ribes triste* (red currant), *Rosa acicularis* (prickly rose), and *Rubus pubescens* (dwarf red blackberry). Herbaceous species include *Carex disperma* (softleaf sedge), *Coptis trifolia* (threeleaf goldthread), *Equisetum sylvaticum* (woodland horsetail), *Galium triflorum* (fragrant bedstraw), *Maianthemum canadense* (Canada mayflower), *Maianthemum trifolium* (threeleaf false lily of the valley), *Mitella nuda* (naked miterwort), *Trientalis borealis* (starflower), and *Viola renifolia* (white violet). The moss layer, which is sometimes patchy, includes *Dicranum polysetum* (dicranum moss), *Hylocomium splendens* (splendid feather moss), *Pleurozium schreberi* (Schreber's big red stem moss), *Ptilium crista-castrensis* (knights plume moss), *Rhytidiadelphus triquetrus* (rough goose neck moss), *Sphagnum capillifolium* (sphagnum), *Sphagnum girgensohnii* (Girgensohn's sphagnum), and *Sphagnum capillifolium* (sphagnum). (Sims et al. 1989, MNNHP 1993, Harris et al. 1996).

MOST ABUNDANT SPECIES

Apostle Islands National Lakeshore

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Larix laricina* (tamarack)
Short shrub/sapling	Broad-leaved evergreen shrub	*Chamaedaphne calyculata* (leatherleaf), *Ledum groenlandicum* (bog Labrador-tea), *Myrica gale* (sweetgale)
Nonvascular	Moss	*Sphagnum centrale* (sphagnum)

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Betula papyrifera* (paper birch), *Chamaedaphne calyculata* (leatherleaf), *Equisetum fluviatile* (water horsetail), *Gaultheria hispidula* (creeping snowberry), *Larix laricina* (tamarack), *Ledum groenlandicum* (bog Labrador-tea), *Maianthemum trifolium* (threeleaf false lily of the valley), *Myrica gale* (sweetgale), *Picea mariana* (black spruce), *Sphagnum centrale* (sphagnum), *Sphagnum fuscum* (sphagnum), *Sphagnum papillosum* (papillose sphagnum)

CONSERVATION STATUS RANK

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

CLASSIFICATION

Status: Standard

Classification Confidence: 2 - Moderate

Global Comments: This type in concept is found in the boreal/mixed conifer-hardwood region (Province 212). It varies from having a tall-shrub layer and more minerotrophic indicators to a more patchy layer with dwarf-shrub/sphagnum mat and fewer minerotrophic indicators. This type lacks the more southern species found in central tamarack minerotrophic swamps, such as *Larix laricina / Photinia melanocarpa / Sphagnum* spp. Forest (CEGL002472), which is found in the hardwood and prairie-forest border regions.

Global Similar Associations:

- *Acer rubrum - Fraxinus* spp. *- Betula papyrifera / Cornus canadensis* Forest (CEGL002071)
- *Larix laricina - Acer rubrum / (Rhamnus alnifolia, Vaccinium corymbosum)* Forest (CEGL005232)--is a more southern minerotrophic version of this type.
- *Larix laricina / Photinia melanocarpa / Sphagnum* spp. Forest (CEGL002472)--This type has a more southern distribution and is more nutrient-poor.

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- *Picea mariana - (Larix laricina) / Ledum groenlandicum / Sphagnum* spp. Forest (CEGL005271)
- *Thuja occidentalis - Larix laricina / Sphagnum* spp. Forest (CEGL005225)

Global Related Concepts:

- Forested fingers (Glaser 1992b) =
- Rich conifer swamp: cedar-(tamarack) (W32) (Harris et al. 1996) I
- Tamarack (Black Spruce) / Speckled Alder / Labrador Tea (V23) (Sims et al. 1989) =

ELEMENT DISTRIBUTION

Apostle Islands National Lakeshore Range: This tamarack swamp forest occurs on the mainland unit at Little Sand Bay Bog and near the campsite at East Bay.

Global Range: This rich to moderately poor tamarack swamp community is found in the northern Great Lakes region of the United States and Canada, ranging from the northern and central parts of Minnesota, Wisconsin, and Michigan to Ontario, Manitoba, and probably elsewhere.

Nations: CA, US

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

TNC Ecoregions: 35:C, 47:C, 48:C

USFS Ecoregions (1994/95): 212Ha:CCP, 212Hb:CCP, 212He:CCP, 212Hh:CCP, 212Hi:CCC, 212Hj:CCP, 212Hk:CCP, 212Hl:CCP, 212Hm:CCP, 212Hn:CCP, 212Ho:CCP, 212Hp:CCP, 212Hq:CCP, 212Hr:CCP, 212Hs:CCP, 212Ht:CCP, 212Hv:CCP, 212Hw:CCP, 212Hy:CCP, 212Ia:CCC, 212Ib:CC?, 212Ja:CCC, 212Jb:CCP, 212Jc:CCP, 212Jk:CCP, 212Jl:CCP, 212Jm:CCP, 212Jn:CCP, 212Jo:CCP, 212Jr:CCP, 212Ka:CCP, 212Kb:CCC, 212La:CCC, 212Mb:CCC, 212Na:CCC, 212Nb:CCP, 212Nc:CCC, 222Na:CCC, M212:C

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

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (2 plots): APIS.037, APIS.705.

Apostle Islands National Lakeshore Map Code: FTR

Local Description Authors: M.J. Russo

Global Description Authors: J. Drake

References: Brewer 1966, Catana 1967, Glaser 1992b, Greenall 1996, Harris et al. 1996, MNNHP 1993, Midwestern Ecology Working Group n.d., Sims et al. 1989, Sytsma and Pippen 1981a, Sytsma and Pippen 1981b

White-cedar - (Mixed Conifer) / Alder Swamp

***Thuja occidentalis - (Picea mariana, Abies balsamea) / Alnus incana* Forest**

Northern White-cedar - (Black Spruce, Balsam Fir) / Gray Alder Forest

Identifier: CEGL002456

NVC CLASSIFICATION

Division	North American Boreal Flooded & Swamp Forest (1.D.2.a)
Macrogroup	Central & Eastern Boreal Flooded & Swamp Forest (MG038)
Group	Tamarack - Conifer Alkaline Swamp (G051)
Association (Common name)	White-cedar - (Mixed Conifer) / Alder Swamp
Ecological System(s):	Laurentian-Acadian Alkaline Conifer-Hardwood Swamp (CES201.575)
	Great Lakes Wooded Dune and Swale (CES201.726)

ELEMENT CONCEPT

Global Summary: This sub-boreal white-cedar - mixed conifer swamp forest is found in the northern Great Lakes region of the United States and Canada. Stands occur on level to gently sloping ground with wet, organic or mineral soil. It is typically along the margins of peatlands, in drainage courses, shores of lakes and rivers above flooding level, or in shallow depressions. The groundwater is moderately minerotrophic and has circumneutral pH. The canopy is often moderately dense to dense. The understory structure consists of high hummocks and deep, water-filled hollows, with fallen, moss-covered logs common. *Thuja occidentalis* (northern white-cedar) is moderately to strongly dominant in the canopy, or *Picea mariana* (black spruce) may overtop the subdominant *Thuja occidentalis* (northern white-cedar). Other species include *Abies balsamea* (balsam fir), *Acer rubrum* (red maple), *Betula papyrifera* (paper birch), *Fraxinus nigra* (black ash), *Larix laricina* (tamarack) and, more rarely, *Picea glauca* (white spruce), or *Tsuga canadensis* (eastern hemlock). The shrub layer in this community is sparse to dense, in inverse proportion to the tree canopy. Species present in this stratum include *Alnus incana* (gray alder), *Chamaedaphne calyculata* (leatherleaf), *Cornus canadensis* (bunchberry dogwood), *Cornus sericea* (red-osier dogwood), *Gaultheria hispidula* (creeping snowberry), *Ledum groenlandicum* (bog Labrador-tea), *Linnaea borealis* (twinflower), *Rosa acicularis* (prickly rose), *Rubus pubescens* (dwarf red blackberry), and *Vaccinium myrtilloides* (velvetleaf huckleberry). *Nemopanthus mucronatus* (catberry) and *Viburnum nudum* var. *cassinoides* (withe-rod) are more common eastward. The most common herbaceous species are *Carex* (sedge) spp. (including *Carex disperma)*, *Coptis trifolia* (threeleaf goldthread), *Clintonia borealis* (bluebead), *Dryopteris carthusiana* (spinulose woodfern), *Galium triflorum* (fragrant bedstraw), *Maianthemum canadense* (Canada mayflower), *Mitella nuda* (naked miterwort), *Trientalis borealis* (starflower), and *Viola*

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renifolia (white violet). Mosses include *Hylocomium splendens* (splendid feather moss), *Pleurozium schreberi* (Schreber's big red stem moss), *Ptilium crista-castrensis* (knights plume moss), *Rhytidiadelphus triquetrus* (rough goose neck moss), *Sphagnum capillifolium* (sphagnum), *Sphagnum girgensohnii* (Girgensohn's sphagnum), and *Sphagnum magellanicum* (Magellan's sphagnum). Moss cover may be thin where the canopy is very dense. Diagnostic species include *Thuja occidentalis* (northern white-cedar) as a dominant/codominant species, with a combination of acidic and minerotrophic understory species, such as *Alnus incana* (gray alder) and *Cornus sericea* (red-osier dogwood).

ENVIRONMENTAL DESCRIPTION

Apostle Islands National Lakeshore Environment: This white-cedar - mixed conifer swamp forest was sampled once on the northwestern corner of Outer Island. The site is a flat depression at 196 m (643 feet) elevation. The soil is a somewhat poorly drained muck. The unvegetated surface is made up of leaf litter (30% cover) and wood (70%). The stand has an old-growth appearance.
Global Environment: This community is found on level to gently sloping ground with wet, organic (Sims et al. 1989) or mineral soil (MNNHP 1993). It is typically along the margins of peatlands, in drainage courses, or shallow depressions. Schwintzer and Tomberlin (1982) reported detailed results on the chemical characteristics of the groundwater of several wetland types in Lower Michigan. They found that it was difficult to differentiate swamps dominated by conifers from those dominated by other vegetation on the basis of groundwater. The swamps were moderately to strongly minerotrophic and had circumneutral pH.

VEGETATION DESCRIPTION

Apostle Islands National Lakeshore Vegetation: The moderate (40% cover) tree canopy, 20-35 m tall, is dominated by *Thuja occidentalis* (northern white-cedar) and *Tsuga canadensis* (eastern hemlock) with lesser amounts of *Abies balsamea* (balsam fir), *Betula alleghaniensis* (yellow birch), and *Betula papyrifera* (paper birch). The moderate (50%) tall-shrub layer (2-5 m) has the same make-up as the canopy. The moderate herbaceous layer (60%) is dominated by *Carex disperma* (softleaf sedge) and includes tree seedlings along with Clintonia borealis, Cornus canadensis, Lycopodium annotinum, Maianthemum canadense, Maianthemum trifolium, Mnium sp., *Scirpus cyperinus* (woolgrass), and *Trientalis borealis* (starflower). The ground surface has a nearly continuous cover (90%) of nonvascular species (mosses) mostly *Sphagnum* (sphagnum) spp.
Global Vegetation: The canopy is often moderately dense to dense (MNNHP 1993). Basal areas of 42.2-62.2 m2/ha and densities of 2457-7565 stems/ha have been reported in four stands in Lower Michigan, using a tree definition of woody stems greater than 2.5 cm dbh (Schwintzer 1981). The understory structure consists of high hummocks and deep, water-filled hollows, with fallen, moss-covered logs common. *Thuja occidentalis* (northern white-cedar) is moderately to strongly dominant in the canopy, or *Picea mariana* (black spruce) may overtop the subdominant *Thuja occidentalis* (northern white-cedar). Other species include *Abies balsamea* (balsam fir), *Acer rubrum* (red maple), *Betula papyrifera* (paper birch), *Fraxinus nigra* (black ash), *Larix laricina* (tamarack) and, more rarely, *Picea glauca* (white spruce) (in northern Minnesota and northwestern Ontario), or *Tsuga canadensis* (eastern hemlock). The shrub layer in this community is sparse to dense, in inverse proportion to the tree canopy. Species present in this stratum include *Alnus incana* (gray alder), *Chamaedaphne calyculata* (leatherleaf), *Cornus canadensis* (bunchberry dogwood), *Cornus sericea* (red-osier dogwood), *Gaultheria hispidula* (creeping snowberry), *Ledum groenlandicum* (bog Labrador-tea), *Linnaea borealis* (twinflower), *Rosa acicularis* (prickly rose), *Rubus pubescens* (dwarf red blackberry), and *Vaccinium myrtilloides* (velvetleaf huckleberry). *Nemopanthus mucronatus* (catberry) and *Viburnum nudum* var. *cassinoides* (withe-rod) are more common eastward. The most common herbaceous species are *Carex* (sedge) spp. (including *Carex disperma), Coptis trifolia* (threeleaf goldthread), *Clintonia borealis* (bluebead), *Dryopteris carthusiana* (spinulose woodfern), *Galium triflorum* (fragrant bedstraw), *Maianthemum canadense* (Canada mayflower), *Mitella nuda* (naked miterwort), *Trientalis borealis* (starflower), and *Viola renifolia* (white violet). Mosses include *Hylocomium splendens* (splendid feather moss), *Pleurozium schreberi* (Schreber's big red stem moss), *Ptilium crista-castrensis* (knights plume moss), *Rhytidiadelphus triquetrus* (rough goose neck moss), *Sphagnum capillifolium* (sphagnum), *Sphagnum girgensohnii* (Girgensohn's sphagnum), and *Sphagnum magellanicum* (Magellan's sphagnum). Moss cover may be thin where the canopy is very dense. Diagnostic species include *Thuja occidentalis* (northern white-cedar) as a dominant/codominant species, with a combination of acidic and more minerotrophic understory species, such as *Alnus incana* (gray alder) and *Cornus sericea* (red-osier dogwood). (Sims et al. 1989, Harris et al. 1996, Chambers et al. 1997)

MOST ABUNDANT SPECIES

Apostle Islands National Lakeshore

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Thuja occidentalis* (northern white-cedar), *Tsuga canadensis* (eastern hemlock)
Tall shrub/sapling	Needle-leaved shrub	*Thuja occidentalis* (northern white-cedar)

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Carex disperma* (softleaf sedge), *Thuja occidentalis* (northern white-cedar), *Tsuga canadensis* (eastern hemlock)

CONSERVATION STATUS RANK

Global Rank & Reasons: G4 (3-Oct-1996). This rank may need to be higher. In Wisconsin, for example, there is very poor regeneration of cedar in many stands. There was also widespread strip cutting on federal lands several decades ago, but little cedar reproduction has occurred. Currently, there is a moratorium on cutting on federal and state lands, but cutting continues on private lands (E. Epstein pers. comm. 1999). Deer browse is also a major factor affecting regeneration (Van Deelen 1999).

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CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Global Comments: The white-cedar seepage type, *Thuja occidentalis - (Larix laricina)* Seepage Forest (CEGL002455) could be lumped with this type, but this type may represent more northern stands. This type may need to be separated into a slightly poorer *Thuja - Larix - Picea* type, *Thuja occidentalis - Larix laricina / Sphagnum* spp. Forest (CEGL005225), and a richer *Thuja* (red cedar) type (see Harris et al. 1996, W31, W32).
Global Similar Associations:
- *Thuja occidentalis - (Larix laricina)* Seepage Forest (CEGL002455)
- *Thuja occidentalis - Abies balsamea / Ledum groenlandicum / Carex trisperma* Woodland (CEGL006507)
- *Thuja occidentalis - Fraxinus nigra* Forest (CEGL005165)
- *Thuja occidentalis - Larix laricina / Sphagnum* spp. Forest (CEGL005225)
- *Thuja occidentalis / Abies balsamea - Acer spicatum* Forest (CEGL002449)
- *Thuja occidentalis / Sphagnum (girgensohnii, warnstorfii)* Forest (CEGL006007)--This type is found in the northeastern United States.
- *Tsuga canadensis - Betula alleghaniensis* Saturated Forest (CEGL005003)

Global Related Concepts:
- Cedar (inc. Mixedwood) / Speckled Alder / Sphagnum Forest (Sims et al. 1989) =
- Conifer Swamp (Schwintzer 1981) =
- Rich Conifer Swamp (cedar) (Chapman et al. 1989) B
- Rich conifer swamp: cedar-(tamarack) (W32) (Harris et al. 1996) I
- Segments 7 and 8 of northern swamps (Clausen 1957) =
- White Cedar-Goldthread-Sphagnum (V38) (Chambers et al. 1997) =

ELEMENT DISTRIBUTION

Apostle Islands National Lakeshore Range: This white-cedar - mixed conifer swamp forest was sampled on Outer Island.
Global Range: This sub-boreal white-cedar - mixed conifer swamp forest is found in the northern Great Lakes region on level to gently sloping ground with wet, organic or mineral soil.
Nations: CA, US
States/Provinces: MB:S2, MI, MN, ON, WI:S3S4
TNC Ecoregions: 35:C, 46:C, 47:C, 48:C
USFS Ecoregions (1994/95): 212Ha:CCC, 212Hb:CCC, 212Hd:CCC, 212He:CCC, 212Hh:CCC, 212Hi:CCC, 212Hj:CCC, 212Hk:CCP, 212Hl:CCC, 212Hm:CCC, 212Hn:CCP, 212Ho:CCP, 212Hp:CCC, 212Hq:CCC, 212Hr:CCP, 212Hs:CCC, 212Ht:CCC, 212Hv:CCC, 212Hw:CCC, 212Hy:CCC, 212Ia:CCC, 212Ib:CCC, 212Ja:CCC, 212Jb:CCP, 212Jc:CCC, 212Je:CCP, 212Jf:CCC, 212Jj:CCC, 212Jk:CCC, 212Jl:CCC, 212Jm:CCC, 212Jn:CCP, 212Jo:CCP, 212Jr:CCP, 212Ka:CCC, 212La:CCC, 212Lb:CCP, 212Lc:CCC, 212Mb:CCC, 212Na:CCC, 212Nb:CCC, 212Nc:CCC, 212Nd:CCC, 212Oa:CCC, 212Pa:CCC, 222Jc:CCC, 222Ke:CCC, 222Mc:CCC, 222Na:CCC
Federal Lands: NPS (Apostle Islands, Isle Royale, Pictured Rocks, Saint Croix, Sleeping Bear Dunes, Voyageurs); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Hiawatha, Huron, Huron-Manistee, Nicolet, Ottawa, Superior)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (1 plot): APIS.022.
Apostle Islands National Lakeshore Map Code: FCS
Local Description Authors: M.J. Russo
Global Description Authors: J. Drake
References: Chambers et al. 1997, Chapman et al. 1989, Clausen 1957, Greenall 1996, Harris et al. 1996, MNNHP 1993, Midwestern Ecology Working Group n.d., Schwintzer 1981, Schwintzer and Tomberlin 1982, Sims et al. 1989, Van Deelen 1999, WNHIP unpubl. data, Wanek and Newman 1976

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2. Shrubland & Grassland

2.C.3. Temperate & Boreal Scrub & Herb Coastal Vegetation

2.C.3.a. Eastern North American Coastal Grassland & Shrubland

MG057. Eastern North American Coastal Grassland & Shrubland

G089. Great Lakes Coast Grassland & Shrubland

Great Lakes Beachgrass Dune

***Ammophila breviligulata* - *(Schizachyrium scoparium)* Herbaceous Vegetation**
American Beachgrass - (Little Bluestem) Herbaceous Vegetation
Identifier: CEGL005098

NVC CLASSIFICATION

Division	Eastern North American Coastal Grassland & Shrubland (2.C.3.a)
Macrogroup	Eastern North American Coastal Grassland & Shrubland (MG057)
Group	Great Lakes Coast Grassland & Shrubland (G089)
Association (Common name)	Great Lakes Beachgrass Dune
Ecological System(s):	Great Lakes Dune (CES201.026)
	Great Lakes Wooded Dune and Swale (CES201.726)

ELEMENT CONCEPT

Global Summary: This beachgrass dune community occurs along the Great Lakes shores region of the United States and Canada on stabilized foredunes. Component plant communities vary from sparsely vegetated, active dunes to communities dominated by grasses, shrubs, and trees, depending on the degree of sand deposition, sand erosion, and distance from the lake. Depositional areas, where Great Lakes beachgrass foredunes are found, are dominated by *Ammophila breviligulata* (American beachgrass) (or in the eastern part of the range *Ammophila champlainensis* (Champlain beachgrass)); erosional areas, such as slacks in blowouts and dune fields, by *Calamovilfa longifolia* (prairie sandreed); and stabilized areas by *Schizachyrium scoparium* (little bluestem). In dune fields and on the most stable dune ridges, especially around northern Lake Michigan and Lake Huron, low evergreen shrubs (*Arctostaphylos uva-ursi* (kinnikinnick), *Juniperus communis* (common juniper), *Juniperus horizontalis* (creeping juniper)) occupy dune crests and also the ground layer in the savanna edge of dunes; elsewhere, deciduous shrubs are dominant, including *Prunus pumila* (sandcherry), *Salix cordata* (heartleaf willow) and *Salix myricoides* (bayberry willow). These two shrubby phases are separated from this open grassland type, but could be treated as phases of this type.

ENVIRONMENTAL DESCRIPTION

Apostle Islands National Lakeshore Environment: This beachgrass dune community was sampled at six locations in the park: one site each on Sand Bay Beach on the mainland unit, the western end of Michigan Island, the southern end of Outer Island, the tombolo on Stockton Island, and on Long and Bear islands. The sites are gently sloping beaches and dunes with any aspect. Elevations range from 186 to 200 m (611-660 feet). Soils are rapidly drained sand. The unvegetated surface is made up of bare sand (40-94% cover), leaf litter (5-50%), wood (0-20%) and large rocks sand (0-5%). Evidence of disturbance includes active dune processes, wind and wave disturbance, and disturbance from human activities.
Global Environment: Environmental processes include sand deposition, sand erosion, and stabilization. They are affected by the distance from the lake. Three sets of environmental habitats can be identified: depositional areas, erosional areas such as slacks in blowouts, and stabilized dune fields.

VEGETATION DESCRIPTION

Apostle Islands National Lakeshore Vegetation: The general appearance of this community is that of a fairly sparse (5-40% cover) grassland. However, there may be a sparse (0-5%) short-shrub layer (0.5-1 m tall) that may include *Pinus strobus* (eastern white pine) and *Salix eriocephala* (Missouri River willow) and a sparse (0-10%) dwarf-shrub layer including *Hudsonia tomentosa* (woolly beach-heather), *Juniperus communis* (common juniper), *Prunus pumila* (sandcherry), and *Toxicodendron radicans* (eastern poison-ivy). The herbaceous layer is dominated by *Ammophila breviligulata* (American beachgrass) along with lesser amounts of *Lathyrus japonicus* (beach pea); additional species may include *Artemisia campestris* (field sagewort), *Asclepias syriaca* (common milkweed), *Elymus canadensis* (Canada wildrye), *Equisetum hyemale* (scouringrush horsetail), and *Oenothera biennis* (common evening-primrose). State-vulnerable (S3) *Deschampsia flexuosa* (wavy hairgrass) was recorded in three of the sampled plots.
Global Vegetation: Component plant communities vary from sparsely vegetated, active dunes to communities dominated by grasses, shrubs, and trees, depending on the degree of sand deposition, sand erosion, and distance from the lake. Depositional areas, where Great Lakes beachgrass foredunes are found, are dominated by *Ammophila breviligulata; erosional areas, such as slacks in blowouts and dune fields, by Calamovilfa longifolia*; and stabilized areas by *Schizachyrium scoparium* (little bluestem). In dune fields and on the most stable dune ridges, especially around northern Lake Michigan and Huron, low evergreen shrubs (*Arctostaphylos uva-ursi* (kinnikinnick), *Juniperus communis* (common juniper), *Juniperus horizontalis* (creeping juniper)) occupy dune crests and also the ground layer in the savanna edge of dunes; elsewhere, deciduous shrubs are dominant, including *Prunus pumila* (sandcherry), *Salix*

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cordata (heartleaf willow) and *Salix myricoides* (bayberry willow). These two shrubby phases are separated from this open grassland type, but could be treated as phases of this type.

MOST ABUNDANT SPECIES

Apostle Islands National Lakeshore

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Ammophila breviligulata* (American beachgrass)

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Ammophila breviligulata* (American beachgrass), *Artemisia campestris* (field sagewort), *Equisetum hyemale* (scouringrush horsetail), *Hudsonia tomentosa* (woolly beach-heather), *Juniperus communis* (common juniper), *Lathyrus japonicus* (beach pea), *Oenothera biennis* (common evening-primrose), *Prunus pumila* (sandcherry)

OTHER NOTEWORTHY SPECIES

Apostle Islands National Lakeshore: Vulnerable: *Deschampsia flexuosa* (wavy hairgrass, state-vulnerable, G5); **Exotic/Invasive**: *Taraxacum officinale* (common dandelion, exotic)
Global: Vulnerable: *Cirsium pitcheri* (sand dune thistle, Federally listed threatened; restricted to Great Lakes beach-grass/sparse foredunes and adjacent dune fields, G3)

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G5 (3-Oct-1996).

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Global Comments: Perhaps 25-35% of Great Lakes dune species grow in maritime dunes (e.g., *Cakile edentula* (American searocket), *Ammophila breviligulata* (American beachgrass), *Hudsonia tomentosa* (woolly beach-heather), *Lathyrus japonicus* var. *maritimus* (beach pea)), but the many western species (such as *Schizachyrium scoparium* (little bluestem)) set Great Lakes dunes apart (as do its endemic plants, such as *Cirsium pitcheri* (sand dune thistle)). In Vermont (Lake Champlain) and New York (eastern Lake Ontario) the dunes apparently contain *Ammophila champlainensis* (Champlain beachgrass) instead of *Ammophila breviligulata* (American beachgrass). This type is linked in complexes with *Juniperus horizontalis - Arctostaphylos uva-ursi - Juniperus communis* Dune Dwarf-shrubland (CEGL005064) and *Prunus pumila - (Ptelea trifoliata*) Dune Shrubland (CEGL005075), which could be treated together as a single association, or treated as a complex open dune type. The sparsely vegetated parts of the dune are included in this association (old CEGL005161).
Global Similar Associations:
- *Cakile edentula* Great Lakes Shore Sparse Vegetation (CEGL005162)
- *Hudsonia tomentosa* Dune Dwarf-shrubland (CEGL004024)
- *Juniperus horizontalis - Arctostaphylos uva-ursi - Juniperus communis* Dune Dwarf-shrubland (CEGL005064)
- *Prunus pumila - (Ptelea trifoliata)* Dune Shrubland (CEGL005075)

Global Related Concepts:
- Lacustrine, Littoral, Unconsolidated Sand Shore, Intermittently Flooded (L2US2) (Cowardin et al. 1979) ?
- Lake Sand Beach (Thompson 1996) B
- Sand Dune Community (Thompson 1996) B

ELEMENT DISTRIBUTION

Apostle Islands National Lakeshore Range: This beachgrass dune community occurs on Sand Bay Beach on the mainland unit, and Michigan, Outer, Stockton, Long, and Bear islands.
Global Range: This community occurs along the Great Lakes shores of the United States and Canada on stabilized foredunes, ranging from Wisconsin to Ontario and New York in the Great Lakes, and in isolated occurrences along the shores of Lake Champlain, Vermont.
Nations: CA, US
States/Provinces: IL, IN, MI, NY, ON, VT, WI:S2?
TNC Ecoregions: 48:C, 64:C
USFS Ecoregions (1994/95): 212Hd:CCC, 212He:CCC, 212Hi:CCC, 212Hj:CCC, 212Hl:CCC, 212Hm:CCP, 212Hn:CCC, 212Ho:CCC, 212Hr:CCP, 212Hw:CCC, 212Hx:CCC, 212Ia:CCC, 212Ja:CCC, 212Oa:CCC, 212Ob:CCC, 212Pa:CCC, 221E:CC, 222Ja:CCC, 222Jj:CCC, 222Kg:CCC
Federal Lands: NPS (Apostle Islands, Indiana Dunes, Pictured Rocks, Sleeping Bear Dunes); USFS (Hiawatha, Huron, Huron-Manistee?, Manistee?)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (6 plots): APIS.016, APIS.115, APIS.139, APIS.201, APIS.220, APIS.329.
Apostle Islands National Lakeshore Map Code: HAB
Local Description Authors: M.J. Russo
Global Description Authors: P. Comer

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References: Cowardin et al. 1979, Farrand and Bell 1982, Midwestern Ecology Working Group n.d., Thompson 1996, Thompson and Sorenson 2000, WNHIP unpubl. data

Great Lakes Beach-heather Dune Dwarf-shrubland

***Hudsonia tomentosa* Dune Dwarf-shrubland**
Woolly Beach-heather Dune Dwarf-shrubland
Identifier: CEGL004024

NVC CLASSIFICATION

Division	Eastern North American Coastal Grassland & Shrubland (2.C.3.a)
Macrogroup	Eastern North American Coastal Grassland & Shrubland (MG057)
Group	Great Lakes Coast Grassland & Shrubland (G089)
Association (Common name)	Great Lakes Beach-heather Dune Dwarf-shrubland
Ecological System(s):	Great Lakes Wooded Dune and Swale (CES201.726)

ELEMENT CONCEPT

Global Summary: This dwarf_shrubland is found in the Great Lakes region of the United States. Stands occur on gently to moderately sloping dunes (dune-swale complex) and sandplains with rapidly drained sand soil. This unique community likely occurs because of the protection by the dunes from north winds and the slightly elevated location on low to midslopes. The slight slope and protection from the wind limit erosion and allow a stable surface for vegetation (versus the shifting sands of the higher dunes). This community is dominated by *Hudsonia tomentosa* (woolly beach-heather), which can often occur in monotypic stands. A very sparse taller shrub layer with species such as *Pinus banksiana* (jack pine), *Populus balsamifera* (balsam poplar), and *Salix interior* (sandbar willow) may be present. The sparse herbaceous layer includes *Ammophila breviligulata* (American beachgrass), *Deschampsia flexuosa* (wavy hairgrass), and *Maianthemum stellatum* (starry false lily of the valley).

ENVIRONMENTAL DESCRIPTION

Apostle Islands National Lakeshore Environment: This beach-heather dune dwarf-shrubland was sampled at three locations in the park: one site on Long Island and two on Stockton Island. The sites are flat to gently sloping dunes with any aspect. Soils are well-drained and sandy. The unvegetated surface is made up of bare sand (50-60% cover), leaf litter (0-30%), and plant stems (10-50%). No evidence of disturbance was reported.
Global Environment: This community consists of sandy or dunal areas dominated by *Hudsonia tomentosa* (woolly beach-heather). It is largely confined to the low and midslope areas of Great Lakes dunes. Stands often contain a cryptobiotic crust on the soil.

VEGETATION DESCRIPTION

Apostle Islands National Lakeshore Vegetation: The general appearance of this community is that of a moderately dense (30-70% cover) *Hudsonia tomentosa* (woolly beach-heather) dwarf-shrubland (<5 m tall). However, there may be a very sparse (5%) emergent tree layer (5-10 m) and tall-shrub layer (2-5 m) that may include *Pinus strobus* (eastern white pine) and *Pinus resinosa* (red pine). There is often also a very sparse (5-10%) short-shrub layer (0.5-1 m) that includes *Juniperus communis* (common juniper), *Prunus pumila* (sandcherry), and *Spiraea alba* (white meadowsweet). The sparse (5-20%) herbaceous layer is dominated by *Ammophila breviligulata* (American beachgrass), along with lesser amounts of *Artemisia campestris* (field sagewort), *Polygonella articulata* (coastal jointweed), and *Toxicodendron radicans* (eastern poison-ivy). Lichens (*Cladina* (reindeer lichen) spp.), when present, cover from 10-30% of the ground surface.
Global Vegetation: This community is dominated by a sparse to moderately dense (25-80% cover), often monotypic, dwarf-shrub layer of *Hudsonia tomentosa* (woolly beach-heather). There may also be a very sparse tall-shrub layer and sparse cover of short shrubs. When present, these include *Pinus banksiana* (jack pine), *Populus balsamifera* (balsam poplar), and *Salix interior* (sandbar willow). The sparse herbaceous layer includes *Ammophila breviligulata* (American beachgrass), *Deschampsia flexuosa* (wavy hairgrass), and *Maianthemum stellatum* (starry false lily of the valley). In addition, this community supports Michigan state-vulnerable *Cirsium pitcheri* (sand dune thistle) and *Tanacetum bipinnatum* ssp. *huronense* (Lake Huron tansy). Nonvascular species (mosses and lichens), including *Cladonia* (cup lichen) sp., and *Cladina rangiferina* (greygreen reindeer lichen), cover up to 50% of the ground surface.

MOST ABUNDANT SPECIES

Apostle Islands National Lakeshore

Stratum	Lifeform	Species
Short shrub/sapling	Dwarf-shrub	*Hudsonia tomentosa* (woolly beach-heather)
Herb (field)	Graminoid	*Ammophila breviligulata* (American beachgrass)

Global

Stratum	Lifeform	Species
Short shrub/sapling	Dwarf-shrub	*Hudsonia tomentosa* (woolly beach-heather)

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Ammophila breviligulata* (American beachgrass), *Hudsonia tomentosa* (woolly beach-heather)
Global: *Hudsonia tomentosa* (woolly beach-heather)

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CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (29-May-2008).

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Global Comments: This association is temporarily placed in an alliance found along the North Atlantic Coastal Plain. It may need to be moved to another alliance based on revisions to the NVC such that it occurs within a Great Lakes dunal group.
Global Similar Associations:

- *Ammophila breviligulata - (Schizachyrium scoparium)* Herbaceous Vegetation (CEGL005098)
- *Hudsonia tomentosa - Arctostaphylos uva-ursi* Dwarf-shrubland (CEGL006143)
- *Hudsonia tomentosa - Lupinus perennis* Dwarf-shrubland (CEGL006233)
- *Hudsonia tomentosa - Paronychia argyrocoma* Dwarf-shrubland (CEGL006232)
- *Hudsonia tomentosa / Panicum amarum* var. *amarulum* Dwarf-shrubland (CEGL003950)
- *Juniperus horizontalis - Arctostaphylos uva-ursi - Juniperus communis* Dune Dwarf-shrubland (CEGL005064)
- *Prunus pumila - (Ptelea trifoliata)* Dune Shrubland (CEGL005075)

ELEMENT DISTRIBUTION

Apostle Islands National Lakeshore Range: This beach-heather dune dwarf-shrubland was sampled on Long Island and Stockton Island.
Global Range: This community is found along dunes and sandplains throughout the northern Great Lakes.
Nations: US
States/Provinces: MI, WI
TNC Ecoregions: 48:C
USFS Ecoregions (1994/95): 212Hi:CCC, 212Ia:CCC
Federal Lands: NPS (Apostle Islands, Pictured Rocks)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (3 AA plots): APIS.AA.063, APIS.AA.511, APIS.AA.612.
Apostle Islands National Lakeshore Map Code: DBH
Local Description Authors: M.J. Russo
Global Description Authors: S.E. Menard
References: Midwestern Ecology Working Group n.d.

Great Lakes Juniper Dune Shrubland

***Juniperus horizontalis - Arctostaphylos uva-ursi - Juniperus communis* Dune Dwarf-shrubland**
Creeping Juniper - Kinnikinnick or Bearberry - Common Juniper Dune Dwarf-shrubland
Identifier: CEGL005064

NVC CLASSIFICATION

Division	Eastern North American Coastal Grassland & Shrubland (2.C.3.a)
Macrogroup	Eastern North American Coastal Grassland & Shrubland (MG057)
Group	Great Lakes Coast Grassland & Shrubland (G089)
Association (Common name)	Great Lakes Juniper Dune Shrubland
Ecological System(s):	Great Lakes Dune (CES201.026)
	Great Lakes Wooded Dune and Swale (CES201.726)

ELEMENT CONCEPT

Global Summary: This dwarf-shrub dune community is found throughout the western Great Lakes region of the United States and Canada. Stands are found on flat-topped, windswept, stabilized dunes. The dwarf-shrubs form an open to closed mat layer. Dominant shrubs include *Arctostaphylos uva-ursi* (kinnikinnick), *Juniperus communis* (common juniper), and *Juniperus horizontalis* (creeping juniper). *Hudsonia tomentosa* (woolly beach-heather) may also be present, along with a variety of other deciduous shrubs. *Ammophila breviligulata* (American beachgrass) and *Schizachyrium scoparium* (little bluestem) are among the herbaceous species found here.

ENVIRONMENTAL DESCRIPTION

Apostle Islands National Lakeshore Environment: This dwarf-shrub dune community was sampled once on the southern end of Outer Island. The site is a dune of rapidly drained sand at 188 m (617 feet) elevation. The unvegetated surface is made up entirely of bare sand (100% cover). There is some evidence of disturbance from human recreational activities.
Global Environment: Stands are found on flat-topped, windswept, stabilized dunes.

VEGETATION DESCRIPTION

Apostle Islands National Lakeshore Vegetation: The sparse (20% cover) short-shrub layer (0.5-1 m tall) is dominated by *Juniperus communis* (common juniper). *Arctostaphylos uva-ursi* (kinnikinnick) and *Hudsonia tomentosa* (woolly beach-heather) form a moderate (40%) dwarf-shrub layer (<0.5 m). The sparse herbaceous layer (20%) includes *Arabis lyrata* (lyrate rockcress), *Carex tonsa*

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var. *rugosperma* (parachute sedge), *Comandra umbellata* (bastard toadflax), *Oenothera biennis* (common evening-primrose), *Sibbaldiopsis tridentata* (shrubby fivefingers), and *Festuca saximontana* (Rocky Mountain fescue). State-vulnerable (S3) *Deschampsia flexuosa* (wavy hairgrass) was recorded in the sampled plot. Nonvascular species (lichens) including *Pleurozium schreberi* (Schreber's big red stem moss) cover 70% of the ground surface.

Global Vegetation: The dwarf-shrubs form an open to closed mat layer. Dominant shrubs include *Arctostaphylos uva-ursi* (kinnikinnick), *Juniperus communis* (common juniper), and *Juniperus horizontalis* (creeping juniper). *Hudsonia tomentosa* (woolly beach-heather) may also be present, along with a variety of other deciduous shrubs. *Ammophila breviligulata* (American beachgrass) and *Schizachyrium scoparium* (little bluestem) are among the herbaceous species found here (Curtis 1959, especially plates 61 and 62, White and Madany 1978, Bakowsky and Lee 1996).

MOST ABUNDANT SPECIES

Apostle Islands National Lakeshore

Stratum	Lifeform	Species
Herb (field)	Dwarf-shrub	*Hudsonia tomentosa* (woolly beach-heather)

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Arctostaphylos uva-ursi* (kinnikinnick), *Carex tonsa* var. *rugosperma* (parachute sedge), *Deschampsia flexuosa* (wavy hairgrass), *Festuca saximontana* (Rocky Mountain fescue), *Hudsonia tomentosa* (woolly beach-heather), *Juniperus communis* (common juniper)

OTHER NOTEWORTHY SPECIES

Apostle Islands National Lakeshore: Vulnerable: *Deschampsia flexuosa* (wavy hairgrass, state-vulnerable, G5)
Global: Vulnerable: *Cirsium pitcheri* (sand dune thistle, Federally listed threatened, G3)

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G4 (24-Oct-2002). This dwarf-shrub dune community has a moderately wide range, being found throughout dune areas of the western Great Lakes region of the United States and Canada. But the dune habitat, per se, is of very limited area. Few Element Occurrences have been documented for this type, partly because it has often been treated as part of a larger dune grassland type. Sites where the type is expected are often under some form of protection. The type is susceptible to natural or human-caused disturbances that may cause dune "blow-outs."

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Global Comments: Type is dominated by evergreen shrubs. Deciduous stands dominated by willows are placed in *Prunus pumila - (Ptelea trifoliata)* Dune Shrubland (CEGL005075). This type may be a minor component of other vegetation types, such as *Ammophila breviligulata - (Schizachyrium scoparium)* Herbaceous Vegetation (CEGL005098), or the Great Lakes Pine Barrens, *Pinus banksiana - (Pinus resinosa) - Pinus strobus / Juniperus horizontalis* Wooded Herbaceous Vegetation (CEGL005125), and it could conceivably be treated as a phase of CEGL005098.
Global Similar Associations:
- *Ammophila breviligulata - (Schizachyrium scoparium)* Herbaceous Vegetation (CEGL005098)
- *Hudsonia tomentosa* Dune Dwarf-shrubland (CEGL004024)
- *Pinus banksiana - (Pinus resinosa) - Pinus strobus / Juniperus horizontalis* Wooded Herbaceous Vegetation (CEGL005125)
- *Prunus pumila - (Ptelea trifoliata)* Dune Shrubland (CEGL005075)

Global Related Concepts:
- Open Dune (Chapman et al. 1989) B

ELEMENT DISTRIBUTION

Apostle Islands National Lakeshore Range: This dwarf-shrub dune community was sampled on Outer Island.
Global Range: This dwarf-shrub dune community is found throughout dune areas of the western Great Lakes region of the United States and Canada, ranging from the shores of southern Michigan in Illinois, Indiana and Michigan northward to the shores of other Great Lakes, such as Lake Superior in Wisconsin.
Nations: CA, US
States/Provinces: IL, IN?, MI, ON:S2, WI
TNC Ecoregions: 48:C
USFS Ecoregions (1994/95): 212Hi:CCC, 212Ho:CCC, 212Hw:CCC, 212Ia:CCC, 212Ja:CCP, 222Kg:CCP
Federal Lands: NPS (Apostle Islands, Pictured Rocks, Sleeping Bear Dunes)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (1 plot): APIS.327.
Apostle Islands National Lakeshore Map Code: DJD
Local Description Authors: M.J. Russo
Global Description Authors: D. Faber-Langendoen

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References: Bakowsky and Lee 1996, Chapman et al. 1989, Curtis 1959, Farrand and Bell 1982, Midwestern Ecology Working Group n.d., WNHIP unpubl. data, White and Madany 1978

Great Lakes Coast Pine Barrens

***Pinus banksiana - (Pinus resinosa) - Pinus strobus / Juniperus horizontalis* Wooded Herbaceous Vegetation**
Jack Pine - (Red Pine) - Eastern White Pine / Creeping Juniper Wooded Herbaceous Vegetation
Identifier: CEGL005125

NVC CLASSIFICATION

Division	Eastern North American Coastal Grassland & Shrubland (2.C.3.a)
Macrogroup	Eastern North American Coastal Grassland & Shrubland (MG057)
Group	Great Lakes Coast Grassland & Shrubland (G089)
Association (Common name)	Great Lakes Coast Pine Barrens
Ecological System(s):	Great Lakes Wooded Dune and Swale (CES201.726)

ELEMENT CONCEPT

Global Summary: This pine barrens type is found in sandy areas along the Great Lakes shores of the United States and Canada. Stands occur on sands on former lake embayments and on some dune-and-swale complexes along the shores of the Great Lakes. Soils are circumneutral dry sands. Where this community occurs as part of a dune-and-swale complex it is found on the slopes and ridges of the dunes. The vegetation forms a coniferous savanna of scattered and clumped trees. Patches of bare sand are common. In the tree layer, *Pinus banksiana* (jack pine) is usually the single most abundant tree, but several other species, including *Pinus resinosa* (red pine) and *Pinus strobus* (eastern white pine) are typically present. Much of the shrub layer is composed of evergreen species, namely *Arctostaphylos uva-ursi* (kinnikinnick), *Hudsonia tomentosa* (woolly beach-heather), *Juniperus horizontalis* (creeping juniper), *Juniperus communis* (common juniper), and *Vaccinium angustifolium* (lowbush blueberry). The most abundant species of the ground layer include *Agrostis hyemalis* (winter bentgrass), *Arabis lyrata* (lyrate rockcress), *Ammophila breviligulata* (American beachgrass), *Calamovilfa longifolia* (prairie sandreed), *Danthonia spicata* (poverty oatgrass), *Deschampsia flexuosa* (wavy hairgrass), and *Toxicodendron radicans* (eastern poison-ivy). In dune-swale complexes, the swales between the dunes are often close enough to the water table to support more mesophytic, sometimes even semi-aquatic, plants. Along the shores of the Great Lakes there is often a dense low or creeping shrub layer.

ENVIRONMENTAL DESCRIPTION

Apostle Islands National Lakeshore Environment: This pine barrens community was sampled once on the Stockton Island tombolo and once on Long Island. The sites are flat dunes with rapidly drained sand. The unvegetated surface is made up of leaf litter (55-73% cover) with some wood (0-1%) and bare sand (25-45%). Evidence of disturbance includes trails and the presence of exotic plants.
Global Environment: This community occurs on sandy former lake embayments and on some dune and swale complexes along the shores of the Great Lakes. Changes in the lake water levels periodically raises the water table. Soils are circumneutral (pH 6.6-7.3) dry sands (Chapman et al. 1989).

VEGETATION DESCRIPTION

Apostle Islands National Lakeshore Vegetation: *Pinus resinosa* (red pine) and/or *Pinus banksiana* (jack pine) form a sparse (20% cover) tree canopy. The sparse (10-40%) shrub layer includes *Pinus* (pine) spp., *Myrica gale* (sweetgale), *Gaylussacia baccata* (black huckleberry), *Juniperus communis* (common juniper), *Populus* (cottonwood) spp., and *Salix* (willow) spp. *Arctostaphylos uva-ursi* (kinnikinnick), *Hudsonia tomentosa* (woolly beach-heather), and *Vaccinium angustifolium* (lowbush blueberry) form a sparse (5-20%) dwarf-shrub layer (<0.5 m). The sparse herbaceous layer (10-30%) includes *Ammophila breviligulata* (American beachgrass), *Calamagrostis canadensis* (bluejoint), *Euthamia graminifolia* (flat-top goldentop), *Lycopus virginicus* (Virginia water horehound), *Maianthemum canadense* (Canada mayflower), *Melampyrum lineare* (narrowleaf cowwheat), and *Symphyotrichum lanceolatum* (white panicle aster). State-vulnerable (S3) *Deschampsia flexuosa* (wavy hairgrass) was recorded in the one of the sampled plots. Nonvascular species (mosses and lichens) including *Pleurozium schreberi* (Schreber's big red stem moss) cover up to 30% of the ground surface.
Global Vegetation: The vegetation forms a coniferous savanna of scattered and clumped trees. Patches of bare sand are common. In the tree layer, *Pinus banksiana* (jack pine) is usually the single most abundant tree, but several other species, including *Pinus resinosa* (red pine) and *Pinus strobus* (eastern white pine) are typically present. Much of the shrub layer is composed of evergreen species, namely *Arctostaphylos uva-ursi* (kinnikinnick), *Hudsonia tomentosa* (woolly beach-heather), *Juniperus horizontalis* (creeping juniper), *Juniperus communis* (common juniper), and *Vaccinium angustifolium* (lowbush blueberry). The most abundant species of the ground layer include *Ammophila breviligulata* (American beachgrass), *Agrostis hyemalis* (winter bentgrass), *Arabis lyrata* (lyrate rockcress), *Calamovilfa longifolia* (prairie sandreed), *Danthonia spicata* (poverty oatgrass), *Deschampsia flexuosa* (wavy hairgrass), and *Toxicodendron radicans* (eastern poison-ivy). In dune-swale complexes, the swales between the dunes are often close enough to the water table to support more mesophytic, sometimes even semi-aquatic, plants. Along the shores of the Great Lakes there is often a dense low or creeping shrub layer (Chapman et al. 1989). Stunted individuals of *Quercus rubra* (northern red oak) are present in stands in Keweenaw County, MI (Chapman et al. 1989).

MOST ABUNDANT SPECIES

Apostle Islands National Lakeshore

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Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus resinosa* (red pine)
Herb (field)	Dwarf-shrub	*Vaccinium angustifolium* (lowbush blueberry)

Global

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus banksiana* (jack pine), *Pinus resinosa* (red pine), *Pinus strobus* (eastern white pine)
Shrub/sapling (tall & short)	Vine/Liana	*Toxicodendron radicans* (eastern poison-ivy)
Short shrub/sapling	Needle-leaved tree	*Juniperus communis* (common juniper)
Short shrub/sapling	Dwarf-shrub	*Arctostaphylos uva-ursi* (kinnikinnick), *Hudsonia tomentosa* (woolly beach-heather), *Juniperus horizontalis* (creeping juniper), *Linnaea borealis* (twinflower)
Herb (field)	Graminoid	*Ammophila breviligulata* (American beachgrass), *Calamovilfa longifolia* (prairie sandreed), *Danthonia spicata* (poverty oatgrass), *Deschampsia flexuosa* (wavy hairgrass), *Festuca saximontana* (Rocky Mountain fescue)

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Ammophila breviligulata* (American beachgrass), *Euthamia graminifolia* (flat-top goldentop), *Lycopus virginicus* (Virginia water horehound), *Maianthemum canadense* (Canada mayflower), *Melampyrum lineare* (narrowleaf cowwheat), *Myrica gale* (sweetgale), *Pinus banksiana* (jack pine), *Pinus resinosa* (red pine), *Symphyotrichum lanceolatum* var. *lanceolatum* (white panicle aster), *Vaccinium angustifolium* (lowbush blueberry)
Global: *Ammophila breviligulata* (American beachgrass), *Hudsonia tomentosa* (woolly beach-heather), *Juniperus horizontalis* (creeping juniper), *Pinus banksiana* (jack pine), *Pinus resinosa* (red pine), *Pinus strobus* (eastern white pine)

OTHER NOTEWORTHY SPECIES

Apostle Islands National Lakeshore: Vulnerable: *Deschampsia flexuosa* (wavy hairgrass, state-vulnerable, G5); **Exotic/Invasive**: *Lythrum salicaria* (purple loosestrife, exotic, High)
Global: Vulnerable: *Cirsium pitcheri* (sand dune thistle, Federally listed threatened; Herbaceous shoreline endemic of the western Great Lakes (Harrison 1988, Bowles et al. 1993). Has been found in this community in Michigan and has been studied by Bowles et al. (1993) in Illinois., G3)

CONSERVATION STATUS RANK

Global Rank & Reasons: G2 (22-Jun-1998). This community is restricted to the Great Lakes area and many sites have been degraded. Good occurrences are found on the Apostle Islands National Park, Wisconsin, and several others in Wisconsin could be restored (including several on Lake Michigan).

CLASSIFICATION

Status: Standard
Classification Confidence: 1 - Strong
Global Comments: In Wisconsin, this type occurs in Lake Superior on the Apostle Islands. The physiognomy of the understory is complex, containing patches of shrub, dwarf-shrub, herbaceous, and sparse vegetation. The ground layer vegetation is somewhat related to the Great Lakes Juniper Dune Shrubland type, *Juniperus horizontalis - Arctostaphylos uva-ursi - Juniperus communis* Dune Dwarf-shrubland (CEGL005064). Several stands on Lake Michigan contain a number of prairie disjuncts (E. Epstein pers. comm. 1999).
Global Similar Associations:
- *Juniperus horizontalis - Arctostaphylos uva-ursi - Juniperus communis* Dune Dwarf-shrubland (CEGL005064)
- *Pinus banksiana - (Quercus ellipsoidalis) / Schizachyrium scoparium* - Prairie Forbs Wooded Herbaceous Vegetation (CEGL002490)
- *Pinus banksiana - Pinus resinosa - Pinus strobus* Dune Forest (CEGL002589)

Global Related Concepts:
- Great Lakes Barren (Chapman et al. 1989) B

ELEMENT DISTRIBUTION

Apostle Islands National Lakeshore Range: This pine barrens community occurs on the Stockton Island tombolo and Long Island.
Global Range: This pine barrens type is found along sandy areas of the Great Lakes shores in the United States and Canada, including areas in Wisconsin, Michigan, and Ontario.
Nations: CA, US
States/Provinces: IN, MI, ON, WI:S1?
TNC Ecoregions: 47:?, 48:C
USFS Ecoregions (1994/95): 212Hi:CCC, 212Hj:CCP, 212Ho:CCC, 212Hw:CCC, 212Ia:CCC, 212Ja:CPP, 212Jb:CP?, 212Jc:CP?, 212Jl:CP?, 212Jn:CP?, 212Oa:CCC, 222Jj:CCC

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Federal Lands: NPS (Apostle Islands, Indiana Dunes, Pictured Rocks, Sleeping Bear Dunes); USFS (Hiawatha, Huron-Manistee, Huron?, Manistee)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (2 plots): APIS.203, APIS.221.
Apostle Islands National Lakeshore Map Code: HPB, HPW
Local Description Authors: M.J. Russo
Global Description Authors: J. Drake and D. Faber-Langendoen
References: Bowles et al. 1993, Chapman et al. 1989, Harrison 1988, Midwestern Ecology Working Group n.d., WNHIP unpubl. data, Zimmerman 1956

2.C.4. Temperate & Boreal Bog & Fen

2.C.4.a. North American Bog & Fen

MG062. North American Boreal Bog & Fen

G185. Boreal Alkaline Peatland

Bog Birch - Willow Shore Fen

***Alnus incana* - *Salix* spp. - *Betula pumila / Chamaedaphne calyculata* Shrubland**
Gray Alder - Willow species - Bog Birch / Leatherleaf Shrubland
Identifier: CEGL005227

NVC CLASSIFICATION

Division	North American Bog & Fen (2.C.4.a)
Macrogroup	North American Boreal Bog & Fen (MG062)
Group	Boreal Alkaline Peatland (G185)
Association (Common name)	Bog Birch - Willow Shore Fen
Ecological System(s):	Laurentian-Acadian Alkaline Fen (CES201.585)

ELEMENT CONCEPT

Global Summary: This bog birch - willow shore fen is found in the northern regions of the midwestern and possibly northeastern United States and in central Canada. Stands occur most commonly along the minerotrophic margins of confined basin peatlands, associated with peatland lakeshore complexes or on "lagg" zones at edges of peatlands where periodic exposure to flooding occurs from groundwater runoff. The substrate is deep fibric to mesic peat. The water regime is saturated to seasonally flooded. Hummock-and-hollow microtopography is well-developed. The shrub layer of this type is dominated by *Betula pumila* var. *glandulifera* (bog birch), with *Alnus incana* (gray alder) and *Salix* (willow) spp. as codominants (including *Salix pyrifolia* (balsam willow), *Salix planifolia* (diamondleaf willow), *Salix pedicellaris* (bog willow), and *Salix petiolaris* (meadow willow)). Other less constant tall shrubs include *Cornus sericea* (red-osier dogwood) and *Rhamnus alnifolia* (alderleaf buckthorn). Shrubs are typically 1.5-3 m tall and coverage ranges from 30-80%. *Chamaedaphne calyculata* (leatherleaf) dominates the dwarf-shrub layer, with lesser amounts of *Ledum groenlandicum* (bog Labrador-tea), *Andromeda polifolia* var. *glaucophylla* (bog rosemary), *Kalmia polifolia* (bog laurel), *Rubus arcticus* ssp. *acaulis* (dwarf raspberry), *Rubus idaeus* (American red raspberry), and *Rubus pubescens* (dwarf red blackberry). Cover of these dwarf-shrubs is typically 60-90%. Often being shaded out by this dense dwarf-shrub layer, the cover of herbaceous plants is variable (20-60%). The most abundant species are *Carex lacustris* (hairy sedge), *Carex leptalea* (bristlystalked sedge), *Carex rostrata* (beaked sedge), *Carex trisperma* (threeseeded sedge), *Maianthemum trifolium* (threeleaf false lily of the valley), and *Comarum palustre* (purple marshlocks). *Calamagrostis canadensis* (bluejoint), *Carex chordorrhiza* (creeping sedge), *Carex lasiocarpa* (woollyfruit sedge), *Eriophorum vaginatum* var. *spissum* (tussock cottongrass), and *Viola* (violet) spp. are also common at low density. The nonvascular stratum in northern Minnesota is dominated by *Sphagnum magellanicum* (Magellan's sphagnum), *Sphagnum angustifolium* (sphagnum), *Sphagnum centrale* (sphagnum), *Sphagnum girgensohnii* (Girgensohn's sphagnum), and *Sphagnum fallax* (sphagnum). These species typically comprise 90-100% cover.

ENVIRONMENTAL DESCRIPTION

Apostle Islands National Lakeshore Environment: This bog birch - willow shore fen was sampled at 10 locations in the park: 2 sites at Sand Bay Bog on the mainland unit, 1 site on Devils Island, 1 on Michigan Island, and 6 on the Stockton Island tombolo. These sites are seasonally flooded to saturated flat depressions and an estuary with somewhat poorly drained to very poorly drained peat and muck soils. The unvegetated surface is made up of leaf litter (0-100% cover), bare soil (0-50%), and standing water (0-55%); two of the stands have no unvegetated surface. Minimal to heavy insect herbivory was observed.
Global Environment: This type is most commonly found along the minerotrophic margins of confined basin peatlands, associated with peatland lakeshore complexes or on "lagg" zones at edges of peatlands where periodic exposure to flooding occurs from groundwater runoff. The substrate is deep fibric to mesic peat. The water regime is saturated to seasonally flooded. Hummock and hollow microtopography is well-developed (Harris et al. 1996).

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VEGETATION DESCRIPTION

Apostle Islands National Lakeshore Vegetation: The dominant feature of this community is the herbaceous layer. However, a sparse (5-20% cover) emergent shrub/tree layer (2-10 m tall) is usually present. In addition, there may be a very sparse to very dense (5-90%) short-shrub layer (<0.5-1 m). Trees include *Larix laricina* (tamarack) and *Pinus strobus* (eastern white pine); tall shrubs may include *Abies balsamea* (balsam fir), *Alnus incana* ssp. *rugosa* (speckled alder), *Betula papyrifera* (paper birch), *Larix laricina* (tamarack), and *Picea mariana* (black spruce). Dominant short shrubs include *Alnus incana* ssp. *rugosa* (speckled alder) and *Ledum groenlandicum* (bog Labrador-tea). *Andromeda polifolia* var. *glaucophylla* (bog rosemary), *Chamaedaphne calyculata* (leatherleaf), and *Vaccinium oxycoccos* (small cranberry) form a very sparse to very dense (5-90%) dwarf-shrub layer (<0.5 m). The variable herbaceous layer (5-70%) includes *Carex lasiocarpa* (woollyfruit sedge), *Carex oligosperma* (fewseed sedge), *Carex utriculata* (Northwest Territory sedge), *Equisetum fluviatile* (water horsetail), *Eriophorum vaginatum* var. *spissum* (tussock cottongrass), *Maianthemum trifolium* (threeleaf false lily of the valley), *Menyanthes trifoliata* (buckbean), *Pogonia ophioglossoides* (snakemouth orchid), and *Rhynchospora alba* (white beaksedge). These sites support numerous insectivorous plants, including *Drosera intermedia* (spoonleaf sundew), *Drosera rotundifolia* (roundleaf sundew), *Sarracenia purpurea* (purple pitcherplant), *Utricularia intermedia* (flatleaf bladderwort), and *Utricularia minor* (lesser bladderwort). The ground surface has sparse to complete cover (20-100%) of *Sphagnum* (sphagnum) spp. In addition, three state-listed plant species were recorded from sampled plots: state-critically imperiled *Carex exilis* (coastal sedge) (S1) and state-imperiled *Carex michauxiana* (Michaux's sedge) and *Rhynchospora fusca* (brown beaksedge) (S2).

Global Vegetation: The shrub layer of this type is dominated by *Betula pumila* var. *glandulifera* (bog birch), with *Alnus incana* (gray alder) and *Salix* (willow) spp. as codominants (including *Salix pyrifolia* (balsam willow), *Salix planifolia* (diamondleaf willow), *Salix pedicellaris* (bog willow), and *Salix petiolaris* (meadow willow)). Other less constant tall shrubs include *Cornus sericea* (red-osier dogwood) and *Rhamnus alnifolia* (alderleaf buckthorn). Shrubs are typically 1.5-3 m tall and coverage ranges from 30-80%. *Chamaedaphne calyculata* (leatherleaf) dominates the dwarf-shrub layer, with lesser amounts of *Ledum groenlandicum* (bog Labrador-tea), *Andromeda polifolia* var. *glaucophylla* (bog rosemary), *Kalmia polifolia* (bog laurel), *Rubus arcticus* ssp. *acaulis* (dwarf raspberry), *Rubus idaeus* (American red raspberry), and *Rubus pubescens* (dwarf red blackberry). Cover of these dwarf-shrubs is typically 60-90%. Often being shaded out by this dense dwarf-shrub layer, the cover of herbaceous plants is variable (20-60%). The most abundant species are *Carex lacustris* (hairy sedge), *Carex leptalea* (bristlystalked sedge), *Carex rostrata* (beaked sedge), *Carex trisperma* (threeseeded sedge), *Maianthemum trifolium* (threeleaf false lily of the valley), and *Comarum palustre* (purple marshlocks). *Calamagrostis canadensis* (bluejoint), *Carex chordorrhiza* (creeping sedge), *Carex lasiocarpa* (woollyfruit sedge), *Eriophorum vaginatum* var. *spissum* (tussock cottongrass), and *Viola* (violet) spp. are also common at low density. The nonvascular stratum in northern Minnesota is dominated by *Sphagnum magellanicum* (Magellan's sphagnum), *Sphagnum angustifolium* (sphagnum), *Sphagnum centrale* (sphagnum), *Sphagnum girgensohnii* (Girgensohn's sphagnum), and *Sphagnum fallax* (sphagnum). These species typically comprise 90-100% cover (Harris et al. 1996, M. Smith pers. comm. 1999).

MOST ABUNDANT SPECIES

Apostle Islands National Lakeshore

Stratum	Lifeform	Species
Short shrub/sapling	Needle-leaved shrub	*Larix laricina* (tamarack)
Short shrub/sapling	Broad-leaved deciduous shrub	*Alnus incana* ssp. *rugosa* (speckled alder)
Short shrub/sapling	Broad-leaved evergreen shrub	*Ledum groenlandicum* (bog Labrador-tea)
Herb (field)	Dwarf-shrub	*Andromeda polifolia* var. *glaucophylla* (bog rosemary), *Chamaedaphne calyculata* (leatherleaf)
Herb (field)	Forb	*Maianthemum trifolium* (threeleaf false lily of the valley)
Herb (field)	Graminoid	*Carex lasiocarpa* (woollyfruit sedge)
Herb (field)	Fern or fern ally	*Equisetum fluviatile* (water horsetail)

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Alnus incana* ssp. *rugosa* (speckled alder), *Andromeda polifolia* var. *glaucophylla* (bog rosemary), *Carex lasiocarpa* (woollyfruit sedge), *Carex oligosperma* (fewseed sedge), *Chamaedaphne calyculata* (leatherleaf), *Drosera rotundifolia* (roundleaf sundew), *Equisetum fluviatile* (water horsetail), *Larix laricina* (tamarack), *Ledum groenlandicum* (bog Labrador-tea), *Maianthemum trifolium* (threeleaf false lily of the valley), *Myrica gale* (sweetgale), *Sarracenia purpurea* (purple pitcherplant), *Vaccinium oxycoccos* (small cranberry)

OTHER NOTEWORTHY SPECIES

Apostle Islands National Lakeshore: Vulnerable: *Carex exilis* (coastal sedge, state-critically imperiled, G5), *Carex michauxiana* (Michaux's sedge, state-imperiled, G5), *Rhynchospora fusca* (brown beaksedge, state-imperiled, G4G5); **Exotic/Invasive**: *Sorbus aucuparia* (european mountain-ash, exotic)

CONSERVATION STATUS RANK

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

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate

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Global Comments: Type concept is that of a tall-shrub shore fen, as described by W16 of Harris et al. (1996). Rangewide review is needed.

Global Similar Associations:

- *Betula pumila / Chamaedaphne calyculata / Carex lasiocarpa* Shrubland (CEGL002494)--is a low-shrub shore fen.
- *Chamaedaphne calyculata - Myrica gale / Carex lasiocarpa* Dwarf-shrubland (CEGL005228)
- *Dasiphora fruticosa* ssp. *floribunda - Myrica gale* Rich Shore Fen Shrubland (CEGL005275)

Global Related Concepts:

- Northern Rich Fen (Chapman et al. 1989) ?
- Tall shrub shore fen: speckled alder-willow / dwarf birch / ericaceous shrub (W16) (Harris et al. 1996) =

ELEMENT DISTRIBUTION

Apostle Islands National Lakeshore Range: This bog birch - willow shore fen is found at Sand Bay Bog on the mainland unit, and on Devils, Michigan, and Stockton islands.
Global Range: This shrub shore fen is found in the northern Great Lakes region of the United States and Canada.
Nations: CA, US
States/Provinces: MI, MN, ON, QC, WI
TNC Ecoregions: 48:C
USFS Ecoregions (1994/95): 212Ia:CCC, 212J:CC, 212La:CCC
Federal Lands: NPS (Apostle Islands, Voyageurs)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (10 plots): APIS.004, APIS.005, APIS.006, APIS.007, APIS.015, APIS.038, APIS.105, APIS.206, APIS.212, APIS.702.
Apostle Islands National Lakeshore Map Code: SAW
Local Description Authors: M.J. Russo
Global Description Authors: D. Faber-Langendoen
References: Chapman et al. 1989, Harris et al. 1996, Midwestern Ecology Working Group n.d., WNHIP unpubl. data

Wiregrass Sedge Shore Fen

***Carex lasiocarpa - (Carex rostrata) - Equisetum fluviatile* Herbaceous Vegetation**
Wiregrass Sedge - (Beaked Sedge) - Water Horsetail Herbaceous Vegetation
Identifier: CEGL005229

NVC CLASSIFICATION

Division	North American Bog & Fen (2.C.4.a)
Macrogroup	North American Boreal Bog & Fen (MG062)
Group	Boreal Alkaline Peatland (G185)
Association (Common name)	Wiregrass Sedge Shore Fen
Ecological System(s):	Laurentian-Acadian Alkaline Fen (CES201.585)

ELEMENT CONCEPT

Global Summary: This community is found typically on floating (or occasionally grounded) mats on the edges of lakes and streams in the Great Lakes region of the United States and Canada. Lakes and streams have low wave and current energy and seasonally flood the mat. Permanent surface pools and small hummocks with *Sphagnum* (sphagnum) spp. and ericaceous shrubs may be present. The substrate is a mat of fibric to mesic peat held together by roots and rhizomes. Graminoids dominate the stand, with shrub cover typically much less than 25%. *Myrica gale* (sweetgale) can be among the more common shrubs. The graminoid *Carex lasiocarpa* (woollyfruit sedge) can form extensive "lawns." Other herbaceous species present include *Carex rostrata* (beaked sedge), *Eleocharis elliptica* (elliptic spikerush), *Equisetum fluviatile* (water horsetail), *Comarum palustre* (purple marshlocks), *Rhynchospora alba* (white beaksedge), *Triadenum fraseri* (Fraser's marsh St. Johnswort), *Utricularia intermedia* (flatleaf bladderwort), and *Utricularia minor* (lesser bladderwort). *Menyanthes trifoliata* (buckbean) can occur at high cover, especially at the outer edge of the floating mat.

ENVIRONMENTAL DESCRIPTION

Apostle Islands National Lakeshore Environment: This wiregrass sedge wetland community was sampled twice at the Sand Bay bog on the mainland unit. The sites are permanently flooded, flat depressions with saturated, very poorly drained muck soil. The unvegetated surface is made up of leaf litter (20-35% cover), bare soil (0-50%), and standing water (0-35%). Evidence of disturbance includes some insect herbivory.
Global Environment: This community is found typically on floating (or occasionally grounded) mats on the edges of lakes and streams. Lakes and streams have low wave and current energy and seasonally flood the mat. Permanent surface pools and small hummocks with *Sphagnum* (sphagnum) spp. and ericaceous shrubs may be present. The substrate is a mat of fibric to mesic peat held together by roots and rhizomes.

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VEGETATION DESCRIPTION

Apostle Islands National Lakeshore Vegetation: There is a sparse (5% cover) short-shrub layer (0.5-1 m tall) that may include *Alnus incana* ssp. *rugosa* (speckled alder) and *Myrica gale* (sweetgale) and a sparse (1-10%) dwarf-shrub layer that may include *Andromeda polifolia* var. *glaucophylla* (bog rosemary), *Chamaedaphne calyculata* (leatherleaf), and *Vaccinium oxycoccos* (small cranberry). The dense (80-90%) herbaceous layer is dominated by *Carex lasiocarpa* (woollyfruit sedge); additional species include *Campanula aparinoides* (marsh bellflower), *Equisetum fluviatile* (water horsetail), *Eriophorum virginicum* (tawny cottongrass), *Menyanthes trifoliata* (buckbean), *Rhynchospora alba* (white beaksedge), and the insectivore *Sarracenia purpurea* (purple pitcherplant). Aquatic species *Utricularia intermedia* (flatleaf bladderwort) is also present. *Sphagnum* (sphagnum) spp. may have up to 30% cover of the ground surface.
Global Vegetation: Graminoids dominate the stand, with shrub cover typically much less than 25%. *Myrica gale* (sweetgale) can be among the more common shrubs. The graminoid *Carex lasiocarpa* (woollyfruit sedge) can form extensive 'lawns.' Other herbaceous species present include *Carex rostrata* (beaked sedge), *Eleocharis elliptica* (elliptic spikerush), *Equisetum fluviatile* (water horsetail), *Comarum palustre* (purple marshlocks), *Rhynchospora alba* (white beaksedge), *Triadenum fraseri* (Fraser's marsh St. Johnswort), *Utricularia intermedia* (flatleaf bladderwort), and *Utricularia minor* (lesser bladderwort). *Menyanthes trifoliata* (buckbean) can occur at high cover, especially at the outer edge of the floating mat (Harris et al. 1996).

MOST ABUNDANT SPECIES

Apostle Islands National Lakeshore

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Carex lasiocarpa* (woollyfruit sedge)

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Andromeda polifolia* var. *glaucophylla* (bog rosemary), *Carex lasiocarpa* (woollyfruit sedge), *Chamaedaphne calyculata* (leatherleaf), *Equisetum fluviatile* (water horsetail), *Menyanthes trifoliata* (buckbean), *Myrica gale* (sweetgale), *Utricularia intermedia* (flatleaf bladderwort), *Vaccinium oxycoccos* (small cranberry)

CONSERVATION STATUS RANK

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

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Global Comments: This type is wetter than low shrub shore fen, *Chamaedaphne calyculata - Myrica gale / Carex lasiocarpa* Dwarf-shrubland (CEGL005228), and has structural similarities to bluejoint meadows, but the mat tends to float and the surface is less frequently flooded (Harris et al. 1996). Shore fens may also resemble Narrow-leaf Sedge Organic meadow marshes in Ontario and the concept of shore fen has not been standardized across the province yet (W. Bakowsky pers. comm. 1999). In the Great Lakes shore fens, a more nutrient-rich type has been described separately, *Calamagrostis canadensis - Carex viridula - Cladium mariscoides - Lobelia kalmii* Herbaceous Vegetation (CEGL005115).
Global Similar Associations:
- *Calamagrostis canadensis - Carex viridula - Cladium mariscoides - Lobelia kalmii* Herbaceous Vegetation (CEGL005115)--is a rich graminoid shore fen in the Great Lakes, and may not typically have *Carex lasiocarpa*.
- *Carex lasiocarpa - Calamagrostis* spp. - (*Eleocharis rostellata*) Herbaceous Vegetation (CEGL002383)
- *Carex lasiocarpa* Herbaceous Vegetation (CEGL001810)
- *Chamaedaphne calyculata - Myrica gale / Carex lasiocarpa* Dwarf-shrubland (CEGL005228)
- *Dasiphora fruticosa* ssp. *floribunda - Myrica gale* Rich Shore Fen Shrubland (CEGL005275)--is a rich shrub shore fen in the Great Lakes region.

Global Related Concepts:
- Northern Rich Fen (Chapman et al. 1989) ?
- Open graminoid shore fen: wire sedge (W14) (Harris et al. 1996) =

ELEMENT DISTRIBUTION

Apostle Islands National Lakeshore Range: This wiregrass sedge wetland is found at Sand Bay Bog on the mainland unit.
Global Range: This community is found typically on floating (or occasionally grounded) mats on the edges of lakes and streams in the Great Lakes region of the United States and Canada. It ranges from northern Minnesota and adjacent Ontario eastward to localized areas of Michigan and New York. In New York, one site (Deer Creek) is known along the shores of eastern Lake Ontario.
Nations: CA, US
States/Provinces: MI, MN, NY, ON, QC, VT, WI:S3
TNC Ecoregions: 47:C, 48:C, 64:C
USFS Ecoregions (1994/95): 212Hi:CCC, 212Ho:CCC, 212Hw:CCC, 212La:CCC, 222Ie:CCC
Federal Lands: NPS (Apostle Islands, Pictured Rocks, Saint Croix, Sleeping Bear Dunes, Voyageurs)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (2 plots): APIS.014, APIS.018.
Apostle Islands National Lakeshore Map Code: HSS

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Local Description Authors: M.J. Russo
Global Description Authors: D. Faber-Langendoen
References: Chapman et al. 1989, Edinger et al. 2002, Harris et al. 1996, Midwestern Ecology Working Group n.d., WNHIP unpubl. data

G053. North American Boreal Acidic Peatland

Leatherleaf - Sweetgale Shore Fen

***Chamaedaphne calyculata - Myrica gale / Carex lasiocarpa* Dwarf-shrubland**
Leatherleaf - Sweetgale / Wiregrass Sedge Dwarf-shrubland
Identifier: CEGL005228

NVC CLASSIFICATION

Division	North American Bog & Fen (2.C.4.a)
Macrogroup	North American Boreal Bog & Fen (MG062)
Group	North American Boreal Acidic Peatland (G053)
Association (Common name)	Leatherleaf - Sweetgale Shore Fen
Ecological System(s):	Great Lakes Wooded Dune and Swale (CES201.726)
	Laurentian-Acadian Alkaline Fen (CES201.585)

ELEMENT CONCEPT

Global Summary: This leatherleaf - sweetgale dwarf-shrubland is typically found on floating mats on the edges of lakes and streams in the Great Lakes region of the United States and Canada. Stands occur where there is low wave and current energy with seasonal flooding. Hummocks with *Sphagnum* (sphagnum) spp. and ericaceous shrubs are often present but small in area. Shallow surface pools of water may persist throughout the growing season. Low shrubs dominate the stands, generally with over 60%. Dominant species include *Chamaedaphne calyculata* (leatherleaf) and *Myrica gale* (sweetgale). *Salix pedicellaris* (bog willow) is often present. The herbaceous layer is variable in cover and composition, sometimes shaded out by the heavy shrub cover. Species include *Calamagrostis canadensis* (bluejoint), *Carex aquatilis* (water sedge), *Carex lasiocarpa* (woollyfruit sedge), *Carex rostrata* (beaked sedge), and *Comarum palustre* (purple marshlocks). Diagnostic features of the type are high cover of *Chamaedaphne calyculata* (leatherleaf) with one or more of the following minerotrophic species present: *Myrica gale* (sweetgale), *Betula pumila* (bog birch), *Salix* (willow) spp., *Carex lacustris* (hairy sedge), *Carex lasiocarpa* (woollyfruit sedge), *Typha latifolia* (broadleaf cattail), *Calamagrostis canadensis* (bluejoint), and *Iris versicolor* (harlequin blueflag).

ENVIRONMENTAL DESCRIPTION

Apostle Islands National Lakeshore Environment: This leatherleaf - sweet gale shore fen was sampled at six locations in the park: one site on the southern end of Outer Island, one on Michigan Island, and four sites on Stockton Island tombolo. Sites are generally flat depressions, but one site on Stockton Island is on a gentle south-facing upper slope. Soils are poorly to very poorly drained peat. The unvegetated surface is made up of leaf litter (15-100% cover) and standing water (0-85%). At one site, the vegetation mat was very dry at the time of sampling, possibly due to a period of drought.
Global Environment: This community is typically found on floating mats on the edges of lakes and streams. Stands occur where there is low wave and current energy, and where seasonal flooding may be expected (Harris et al. 1996). Seasonal flooding apparently tends to produce somewhat intermediate nutrient conditions, but depending on degree of flooding and water chemistry, individual stands may vary from moderately poor to moderately rich.

VEGETATION DESCRIPTION

Apostle Islands National Lakeshore Vegetation: The very sparse to moderately dense (5-70%) short-shrub layer (0.5-1 m) is dominated by *Myrica gale* (sweetgale); additional shrubs may include *Alnus incana* (gray alder), *Ilex verticillata* (common winterberry), *Nemopanthus mucronatus* (catberry), and *Salix* (willow) spp. *Chamaedaphne calyculata* (leatherleaf) dominates the very sparse to moderately dense (5-70%) dwarf-shrub layer (<0.5 m), along with lesser amounts of *Andromeda polifolia* var. *glaucophylla* (bog rosemary), *Vaccinium macrocarpon* (cranberry), and *Vaccinium oxycoccos* (small cranberry). The variable herbaceous layer (5-60%) includes *Carex* (sedge) spp., *Cladium mariscoides* (smooth sawgrass), *Juncus canadensis* (Canadian rush), and *Menyanthes trifoliata* (buckbean), as well as orchids *Calopogon tuberosus* (tuberous grasspink) and *Pogonia ophioglossoides* (snakemouth orchid) and insectivores *Drosera intermedia* (spoonleaf sundew), *Drosera rotundifolia* (roundleaf sundew), *Sarracenia purpurea* (purple pitcherplant), and *Utricularia intermedia* (flatleaf bladderwort). The ground surface has sparse to total cover (5-100%) of *Sphagnum* (sphagnum) spp. In addition, the state-critically imperiled (S1) *Carex exilis* (coastal sedge) and state-imperiled (S2) *Rhynchospora fusca* (brown beaksedge) (50% cover at one site) were recorded in the sampled plots.
Global Vegetation: Hummocks with *Sphagnum* (sphagnum) spp. and ericaceous shrubs are often present, but small in area. Shallow surface pools of water may persist throughout the growing season. Low shrubs dominate the stands, generally over 60%. Dominant species include *Chamaedaphne calyculata* (leatherleaf) and *Myrica gale* (sweetgale). *Salix pedicellaris* (bog willow) is often present. The herbaceous layer is variable in cover and composition, sometimes shaded out by the heavy shrub cover. Species include *Calamagrostis canadensis* (bluejoint), *Carex aquatilis* (water sedge), *Carex lasiocarpa* (woollyfruit sedge), *Carex rostrata* (beaked sedge), and *Comarum palustre* (purple marshlocks). Diagnostic features of the type are high cover of *Chamaedaphne calyculata* (leatherleaf) with one or more of the following minerotrophic species present: *Myrica gale* (sweetgale), *Betula pumila* (bog birch),

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Salix (willow) spp., *Carex lacustris* (hairy sedge), *Carex lasiocarpa* (woollyfruit sedge), *Typha latifolia* (broadleaf cattail), *Calamagrostis canadensis* (bluejoint), and *Iris versicolor* (harlequin blueflag) (Harris et al. 1996).

MOST ABUNDANT SPECIES

Apostle Islands National Lakeshore

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved evergreen shrub	*Myrica gale* (sweetgale)
Herb (field)	Dwarf-shrub	*Chamaedaphne calyculata* (leatherleaf)
Herb (field)	Graminoid	*Carex exilis* (coastal sedge), *Rhynchospora fusca* (brown beaksedge)

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Carex exilis* (coastal sedge), *Chamaedaphne calyculata* (leatherleaf), *Cladium mariscoides* (smooth sawgrass), *Juncus canadensis* (Canadian rush), *Myrica gale* (sweetgale), *Pogonia ophioglossoides* (snakemouth orchid), *Rhynchospora fusca* (brown beaksedge), *Sarracenia purpurea* (purple pitcherplant), *Vaccinium oxycoccos* (small cranberry)

OTHER NOTEWORTHY SPECIES

Apostle Islands National Lakeshore: Vulnerable: *Carex exilis* (coastal sedge, state-critically imperiled, G5), *Rhynchospora fusca* (brown beaksedge, state-imperiled, G4G5)
Global: Vulnerable: *Iris lacustris* (dwarf lake iris, Federally listed threatened, G3)

CONSERVATION STATUS RANK

Global Rank & Reasons: G4G5 (24-Mar-2000). Type is expected to be fairly common in Canada.

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Global Comments: Diagnostic features of the type are high cover of *Chamaedaphne calyculata* (leatherleaf) with one or more of the following minerotrophic species present: *Myrica gale* (sweetgale), *Betula pumila* var. *glandulifera* (bog birch), *Salix* (willow) spp., *Carex lacustris* (hairy sedge), *Carex lasiocarpa* (woollyfruit sedge), *Typha latifolia* (broadleaf cattail), *Calamagrostis canadensis* (bluejoint), and *Iris versicolor* (harlequin blueflag). Depending on the site, nutrient conditions may vary; however, rich shore fens along the Great Lakes are treated as a separate type, *Dasiphora fruticosa* ssp. *floribunda* - *Myrica gale* Rich Shore Fen Shrubland (CEGL005275). This type differs from the Leatherleaf Bog, *Chamaedaphne calyculata* - *Ledum groenlandicum* - *Kalmia polifolia* Bog Dwarf-shrubland (CEGL005278), and the Leatherleaf Poor Fen, *Chamaedaphne calyculata / Carex oligosperma / Sphagnum* spp. Poor Fen Dwarf-shrubland (CEGL005277) in that it harbors more minerotrophic indicator species which the Leatherleaf types lack, and tends to have less acidic indicators, such as *Carex oligosperma* (fewseed sedge). When cover of *Betula pumila* var. *glandulifera* (bog birch) and *Salix* (willow) spp. increases, this community can grade into a Bog Birch - Willow Shore Fen, *Alnus incana* - *Salix* spp. - *Betula pumila / Chamaedaphne calyculata* Shrubland (CEGL005227), or a Dogwood - Pussy Willow swamp, *Cornus sericea* - *Salix* spp. - (*Rosa palustris* (swamp rose)) Shrubland (CEGL002186). Greater than 25% cover of short (not dwarf) shrubs would warrant placing the stand into one of these other communities. This type is drier than graminoid shore fen, *Carex lasiocarpa* - *(Carex rostrata)* - *Equisetum fluviatile* Herbaceous Vegetation (CEGL005229), and is transitional to saturated rich and poor fens. Shore fens may also resemble organic shrub swamps in Ontario and the concept of shore fen has not been standardized across the province yet (W. Bakowsky pers. comm. 1999).
Global Similar Associations:
- *Alnus incana* - *Salix* spp. - *Betula pumila / Chamaedaphne calyculata* Shrubland (CEGL005227)
- *Carex lasiocarpa* - *(Carex rostrata)* - *Equisetum fluviatile* Herbaceous Vegetation (CEGL005229)
- *Chamaedaphne calyculata* - *Ledum groenlandicum* - *Kalmia polifolia* Bog Dwarf-shrubland (CEGL005278)
- *Chamaedaphne calyculata / Carex oligosperma / Sphagnum* spp. Poor Fen Dwarf-shrubland (CEGL005277)
- *Cornus sericea* - *Salix* spp. - (*Rosa palustris*) Shrubland (CEGL002186)
- *Dasiphora fruticosa* ssp. *floribunda* - *Myrica gale* Rich Shore Fen Shrubland (CEGL005275)--is a rich shore fen along the Great Lakes shoreline.
- *Myrica gale* - *Spiraea alba* - *Chamaedaphne calyculata* Shrubland (CEGL006512)
- *Myrica gale* Fen Shrubland (CEGL005141)
- *Myrica gale* Organic Swamp Shrubland (CEGL005077)

Global Related Concepts:
- Low shrub shore fen: leatherleaf - sweet gale / graminoid (W15) (Harris et al. 1996) =
- Northern Rich Fen (Chapman et al. 1989) ?

ELEMENT DISTRIBUTION

Apostle Islands National Lakeshore Range: This leatherleaf - sweet gale shore fen occurs on Outer, Michigan, and Stockton islands.
Global Range: This community is typically found on floating mats on the edges of lakes and streams in the Great Lakes region of the United States and Canada. It ranges from northern Minnesota and adjacent Ontario eastward to localized areas of Michigan and New York. In New York, one site (Deer Creek) is known along the shores of eastern Lake Ontario.
Nations: CA, US

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States/Provinces: MI, MN, NY, ON, QC:S4?, VT, WI:S3
TNC Ecoregions: 47:C, 48:C, 64:C
USFS Ecoregions (1994/95): 212Hi:CCC, 212Ia:CCC, 212Ja:CCC, 212La:CCC, 222Ie:CCC
Federal Lands: NPS (Apostle Islands, Isle Royale, Pictured Rocks, Saint Croix, Sleeping Bear Dunes, Voyageurs)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (6 plots): APIS.111, APIS.207, APIS.208, APIS.326, APIS.400, APIS.704.
Apostle Islands National Lakeshore Map Code: DLS
Local Description Authors: M.J. Russo
Global Description Authors: D. Faber-Langendoen
References: Chapman et al. 1989, Edinger et al. 2002, Harris et al. 1996, Midwestern Ecology Working Group n.d., WNHIP unpubl. data

Leatherleaf Poor Fen

***Chamaedaphne calyculata / Carex oligosperma / Sphagnum* spp. Poor Fen Dwarf-shrubland**
Leatherleaf / Few-seed Sedge / Peatmoss species Poor Fen Dwarf-shrubland
Identifier: CEGL005277

NVC CLASSIFICATION

Division	North American Bog & Fen (2.C.4.a)
Macrogroup	North American Boreal Bog & Fen (MG062)
Group	North American Boreal Acidic Peatland (G053)
Association (Common name)	Leatherleaf Poor Fen
Ecological System(s):	Boreal-Laurentian Bog (CES103.581)
	Boreal-Laurentian-Acadian Acidic Basin Fen (CES201.583)
	Boreal-Laurentian Conifer Acidic Swamp (CES103.724)

ELEMENT CONCEPT

Global Summary: This dwarf-shrub poor fen community is found in the northern Great Lakes region and across much of central Canada. Sites are found on peatlands with low exposure to mineral-rich groundwater, including basin fens, shores above the level of seasonal flooding, and margins of larger peatlands. Stands have a saturated hydrology with a fibric *Sphagnum* (sphagnum) spp. peat soil and a pH usually <4.5. Vegetation is dominated by an open dwarf-shrub/scrub conifer layer with very scattered trees (<10% cover). Microtopography is high to intermediate hummocks with hollows or a flat lawn of *Sphagnum* (sphagnum) spp. Ericaceous dwarf-shrubs are dominant, including *Chamaedaphne calyculata* (leatherleaf), *Kalmia polifolia* (bog laurel), and *Ledum groenlandicum* (bog Labrador-tea), and the creeping dwarf-shrubs *Andromeda polifolia* (bog rosemary) and *Vaccinium oxycoccos* (small cranberry). *Betula pumila* (bog birch) has low cover but is fairly constant. Scrub conifers include *Larix laricina* (tamarack) and *Picea mariana* (black spruce). They also occur as scattered trees (>3 m). The herb layer is species-poor, containing *Carex oligosperma* (fewseed sedge), *Carex limosa* (mud sedge), *Equisetum fluviatile* (water horsetail), *Menyanthes trifoliata* (buckbean), *Sarracenia purpurea* (purple pitcherplant), and *Scheuchzeria palustris* (rannoch-rush). The moss layer forms a continuous hummocky mat dominated by *Sphagnum angustifolium* (sphagnum), *Sphagnum fuscum* (sphagnum), and *Sphagnum magellanicum* (Magellan's sphagnum). Diagnostic features include the dominance of a dwarf-shrub ericaceous layer, absence of a tree layer (<10%), species-poor herbaceous layer, and a low abundance of minerotrophic indicators, such as *Betula pumila* (bog birch), *Carex aquatilis* (water sedge) and *Carex stricta* (upright sedge).

ENVIRONMENTAL DESCRIPTION

Apostle Islands National Lakeshore Environment: This dwarf-shrub wetland community was sampled at six locations in the park: 3 sites on Long Island, 2 sites on Michigan Island and 1 site on Outer Island. The sites are seasonally flooded to saturated flat depressions at elevations ranging from 180 to 214 m (590-700 feet). Soils are poorly drained to very poorly drained peat with hummock-and-hollow microtopography. The ground surface is covered almost entirely by nonvascular species (90-100% cover) with some leaf litter (0-5%). No evidence of disturbance was reported.
Global Environment: Sites are found on peatlands with low exposure to mineral-rich groundwater, including basin fens, shores above the level of seasonal flooding, and margins of larger peatlands. Stands have a saturated hydrology with a fibric *Sphagnum* (sphagnum) spp. peat soil and a pH usually <4.5. (Harris et al. 1996).

VEGETATION DESCRIPTION

Apostle Islands National Lakeshore Vegetation: The general appearance of this community is that of a dwarf-shrubland. However, a few of the stands are being invaded by tree saplings (1-5 m tall), including *Alnus incana* (gray alder), *Larix laricina* (tamarack), *Picea mariana* (black spruce), *Pinus strobus* (eastern white pine) and *Pinus strobus* (eastern white pine) with up to 20% cover. The moderate to dense (50-80%) dwarf-shrub layer is dominated by *Chamaedaphne calyculata* (leatherleaf) with lesser amounts of *Kalmia polifolia* (bog laurel) and *Vaccinium oxycoccos* (small cranberry). The sparse (20-30%) herbaceous layer includes *Carex utriculata* (Northwest Territory sedge), *Carex oligosperma* (fewseed sedge), *Carex trisperma* (threeseeded sedge), *Eriophorum vaginatum* var. *spissum* (tussock cottongrass), *Eriophorum virginicum* (tawny cottongrass), *Maianthemum trifolium* (threeleaf false lily of the valley),

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Scheuchzeria palustris (rannoch-rush), and the insectivore *Sarracenia purpurea* (purple pitcherplant). The ground surface has a nearly continuous cover (90-100%) of nonvascular species (mosses), mostly *Sphagnum* (sphagnum) spp.

Global Vegetation: The vegetation is dominated by an open dwarf-shrub/scrub conifer layer with very scattered trees (<10% cover). Microtopography is high to intermediate hummocks with hollows or a flat lawn of *Sphagnum* (sphagnum) spp. Ericaceous dwarf-shrubs are dominant, including *Chamaedaphne calyculata* (leatherleaf), *Kalmia polifolia* (bog laurel), and *Ledum groenlandicum* (bog Labrador-tea), and the creeping dwarf-shrubs *Andromeda polifolia* (bog rosemary) and *Vaccinium oxycoccos* (small cranberry). *Betula pumila* (bog birch) has low cover but is fairly constant. Scrub conifers include *Larix laricina* (tamarack) and *Picea mariana* (black spruce). They also occur as scattered trees (>3 m). The herb layer is species-poor, containing *Carex oligosperma* (fewseed sedge), *Carex limosa* (mud sedge), *Equisetum fluviatile* (water horsetail), *Menyanthes trifoliata* (buckbean), *Sarracenia purpurea* (purple pitcherplant), and *Scheuchzeria palustris* (rannoch-rush). Minerotrophic indicators include *Carex aquatilis* (water sedge), *Carex rostrata* (beaked sedge), and *Carex stricta* (upright sedge). The moss layer forms a continuous hummocky mat dominated by *Sphagnum angustifolium* (sphagnum), *Sphagnum fuscum* (sphagnum), and *Sphagnum magellanicum* (Magellan's sphagnum) (Harris et al. 1996).

MOST ABUNDANT SPECIES

Apostle Islands National Lakeshore

Stratum	Lifeform	Species
Herb (field)	Dwarf-shrub	*Chamaedaphne calyculata* (leatherleaf)
Herb (field)	Graminoid	*Carex utriculata* (Northwest Territory sedge)

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Carex utriculata* (Northwest Territory sedge), *Chamaedaphne calyculata* (leatherleaf), *Eriophorum vaginatum* var. *spissum* (tussock cottongrass), *Eriophorum virginicum* (tawny cottongrass), *Kalmia polifolia* (bog laurel), *Sarracenia purpurea* (purple pitcherplant), *Vaccinium oxycoccos* (small cranberry)

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (29-Mar-2000).

CLASSIFICATION

Status: Standard

Classification Confidence: 2 - Moderate

Global Comments: It is difficult to distinguish this leatherleaf poor fen from leatherleaf bogs in the field, but conceptually this type has somewhat more minerotrophic influence and a corresponding set of minerotrophic indicators. When minerotrophic indicators are absent or "very low", the type is placed in *Chamaedaphne calyculata - Ledum groenlandicum - Kalmia polifolia* Bog Dwarf-shrubland (CEGL005278) (Harris et al. 1996). Stands with sparse black spruce-tamarack layer (<10% tree cover) are part of this type. Stands with 10-25% black spruce and tamarack cover are placed in black spruce/leatherleaf semi-treed bog, *Picea mariana / Chamaedaphne calyculata / Sphagnum* spp. Dwarf-shrubland (CEGL005218). This type also overlaps closely with a "scrubby poor fen type" *Larix laricina / Chamaedaphne calyculata / Carex lasiocarpa* Shrubland (CEGL005226). There are intermediates between this poor fen and sedge meadows, such as when *Sphagnum* (sphagnum) spp. and *Chamaedaphne calyculata* (leatherleaf) have invaded a *Carex rostrata* (beaked sedge) meadow and the *Carex rostrata* (beaked sedge) is hanging on because it still has deep rooting in the underlying minerotrophic peat or mineral soil (N. Aaseng pers. comm. 2000).

Global Similar Associations:

- *Betula pumila / Chamaedaphne calyculata / Carex lasiocarpa* Shrubland (CEGL002494)
- *Carex oligosperma - Carex pauciflora - Eriophorum vaginatum / Sphagnum* spp. Herbaceous Vegetation (CEGL005256)
- *Chamaedaphne calyculata - Ledum groenlandicum - Kalmia polifolia* Bog Dwarf-shrubland (CEGL005278)
- *Chamaedaphne calyculata - Myrica gale / Carex lasiocarpa* Dwarf-shrubland (CEGL005228)
- *Chamaedaphne calyculata / Carex oligosperma - Eriophorum virginicum* Dwarf-shrubland (CEGL005092)
- *Chamaedaphne calyculata / Carex oligosperma / Sphagnum* spp. Dwarf-shrubland (CEGL005091)--This type can form in seepy areas of "burned out" bogs.
- *Chamaedaphne calyculata / Eriophorum virginicum / Sphagnum rubellum* Dwarf-shrubland (CEGL006513)
- *Picea mariana / Chamaedaphne calyculata / Sphagnum* spp. Dwarf-shrubland (CEGL005218)--This type is a leatherleaf bog with a scattered tree layer (10-25%), or muskeg.

Global Related Concepts:

- Poor fen: black spruce - tamarack / ericaceous shrub / Sphagnum (W22) (Harris et al. 1996) F
- Poor fen: ericaceous shrub / Sphagnum (W21) (Harris et al. 1996) F

ELEMENT DISTRIBUTION

Apostle Islands National Lakeshore Range: This dwarf-shrub wetland community is found on Long, Michigan, and Outer islands.

Global Range: This dwarf-shrub poor fen community is found in the northern Great Lakes region and across much of central Canada, ranging from the eastern lake states west to Minnesota, and northward from Quebec to Manitoba and other parts of Canada.

Nations: CA, US

States/Provinces: MI, MN:S4, ON, QC:S3S4, WI:S4

TNC Ecoregions: 46:?, 47:C, 48:C, 64:C

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USFS Ecoregions (1994/95): 212Hi:CCC, 212Ho:CCC, 212Hw:CCC, 212Ia:CCC, 212J:CC, 212K:CC, 212L:CC, 212M:CP, 212N:CP, 212O:CC, 212P:CC, 222J:C?, 222K:C?
Federal Lands: NPS (Apostle Islands, Isle Royale, Pictured Rocks, Saint Croix, Sleeping Bear Dunes, Voyageurs); USFS (Chequamegon, Chequamegon-Nicolet, Chippewa, Hiawatha, Huron, Huron-Manistee, Manistee, Nicolet, Ottawa, Superior)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (6 plots): APIS.112, APIS.117, APIS.224, APIS.225, APIS.228, APIS.323.
Apostle Islands National Lakeshore Map Code: DLF
Local Description Authors: M.J. Russo
Global Description Authors: D. Faber-Langendoen
References: Harris et al. 1996, MNNHP 1993, Midwestern Ecology Working Group n.d., WNHIP unpubl. data

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

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
Ecological System(s):	Eastern Great Plains Wet Meadow, Prairie and Marsh (CES205.687)
	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), *Eupatorium maculatum* (spotted joepyeweed), *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

Apostle Islands National Lakeshore Environment: This wet meadow community was sampled three times in the park, twice on Stockton Island and once on the eastern end of Michigan Island. The sites are seasonally flooded to saturated flat depressions (abandoned beaver ponds) at 191 to 222 m (627-727 feet) elevation. One site was very dry due to a lack of rain. The soils are poorly drained muck. The unvegetated surface is made up of either leaf litter (0-100% cover) or bare soil (0-100%). Evidence of disturbance includes past 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.

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VEGETATION DESCRIPTION

Apostle Islands National Lakeshore Vegetation: This herbaceous wetland is dominated by *Calamagrostis canadensis* (bluejoint) with 15-85% cover; other dominants may include *Calla palustris* (water arum), *Glyceria canadensis* (rattlesnake mannagrass), *Lysimachia terrestris* (earth loosestrife), *Onoclea sensibilis* (sensitive fern), *Scirpus cyperinus* (woolgrass), and *Symphyotrichum puniceum* (purplestem aster). Nonvascular species (mosses), mostly *Sphagnum* (sphagnum) spp., may cover up to 50% of the ground surface.

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 joepyeweed), *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

Apostle Islands National Lakeshore

Stratum	Lifeform	Species
Herb (field)	Forb	*Calla palustris* (water arum), *Symphyotrichum puniceum* var. *puniceum* (purplestem aster)
Herb (field)	Graminoid	*Calamagrostis canadensis* (bluejoint)

Global

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Calamagrostis canadensis* (bluejoint)

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Calamagrostis canadensis* (bluejoint), *Calla palustris* (water arum), *Glyceria canadensis* (rattlesnake mannagrass), *Onoclea sensibilis* (sensitive fern), *Scirpus cyperinus* (woolgrass), *Symphyotrichum puniceum* var. *puniceum* (purplestem aster)

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) ?

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- SNE low-energy riverbank community (Rawinski 1984) ?
- Shallow Emergent Marsh (Thompson 1996) ?

ELEMENT DISTRIBUTION

Apostle Islands National Lakeshore Range: This wet meadow community occurs on Stockton Island and Michigan Island.
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?)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (3 plots): APIS.109, APIS.113, APIS.314.
Apostle Islands National Lakeshore 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
Ecological System(s):	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), *Symphyotrichum lanceolatum* var. *lanceolatum* (white panicle aster), *Campanula aparinoides* (marsh bellflower), *Eupatorium maculatum* (spotted joepyeweed), *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.

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ENVIRONMENTAL DESCRIPTION

Apostle Islands National Lakeshore Environment: This northern tall sedge community was sampled twice on Sand Island, twice on Long Island, and once at Quarry Bay on Stockton Island. The sites are seasonally to semipermanently flooded flat depressions. Elevations range from 183 to 206 m (599-676 feet). Soils are poorly to very poorly drained muck. The unvegetated surface is dominated by leaf litter (30-100% cover) and bare soil (0-60%); one site has 90% standing water. Evidence of disturbance includes past beaver activity and some exotic plants.

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

Apostle Islands National Lakeshore Vegetation: The herbaceous layer dominates this wetland community; however, there may be a very sparse (5% cover) emergent shrub layer (1-5 m tall) that includes *Alnus incana* ssp. *rugosa* (speckled alder), *Betula papyrifera* (paper birch), *Cornus sericea* (red-osier dogwood), *Salix lucida* (shining willow), and/or *Salix petiolaris* (meadow willow). The moderate to dense (50-90%) herbaceous layer (up to 2 m tall) is dominated by sedges, including *Carex lacustris* (hairy sedge), *Carex lasiocarpa* (woollyfruit sedge), and/or *Carex utriculata* (Northwest Territory sedge); additional dominants may include *Calamagrostis canadensis* (bluejoint), *Glyceria grandis* (American mannagrass), *Impatiens capensis* (jewelweed), *Onoclea sensibilis* (sensitive fern), *Phalaris arundinacea* (reed canarygrass), *Scirpus cyperinus* (woolgrass), and *Triadenum fraseri* (Fraser's marsh St. Johnswort). Floating aquatics include *Utricularia intermedia* (flatleaf bladderwort) and *Brasenia schreberi* (watershield). Nonvascular species (mosses) cover up to 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), *Symphyotrichum lanceolatum* var. *lanceolatum* (white panicle aster), *Campanula aparinoides* (marsh bellflower), *Eupatorium maculatum* (spotted joepyeweed), *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

Apostle Islands National Lakeshore

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Carex lasiocarpa* (woollyfruit sedge), *Carex utriculata* (Northwest Territory sedge), *Glyceria grandis* (American mannagrass), *Scirpus cyperinus* (woolgrass)

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Calamagrostis canadensis* (bluejoint), *Carex lacustris* (hairy sedge), *Carex lasiocarpa* (woollyfruit sedge), *Carex utriculata* (Northwest Territory sedge), *Glyceria grandis* (American mannagrass), *Impatiens capensis* (jewelweed), *Onoclea sensibilis* (sensitive fern), *Phalaris arundinacea* (reed canarygrass), *Scirpus cyperinus* (woolgrass), *Triadenum fraseri* (Fraser's marsh St. Johnswort), *Utricularia intermedia* (flatleaf bladderwort)

OTHER NOTEWORTHY SPECIES

Apostle Islands National Lakeshore: Exotic/Invasive: *Lythrum salicaria* (purple loosestrife, exotic, High), *Tanacetum vulgare* (common tansy, exotic, Low)

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 Virginica 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 *Symphyotrichum puniceum* (purplestem aster), *Campanula aparinoides* (marsh bellflower), *Glyceria canadensis*

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(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

Apostle Islands National Lakeshore Range: This northern tall sedge community is found Sand Island, Long Island, and at Quarry Bay on Stockton Island.

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, 212Jj:CCP, 212Jk:CCP, 212Jl:CCP, 212Jm:CCP, 212Jn:CCP, 212Jo:CCP, 212Jr:CCP, 212Ka:CCC, 212La:CCP, 212Lb:CCC, 212Lc:CCP, 212Ld:CCP, 212Mb:CPP, 212Na:CPP, 212Nb:CPP, 212Nc:CPP, 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)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (5 plots): APIS.102, APIS.128, APIS.133, APIS.218, APIS.219.

Apostle Islands National Lakeshore 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

G189. Herbaceous Forested Seep

Clay Seeps

Clay Seeps Sparse Vegetation
Clay Seeps Sparse Vegetation
Identifier: CEGL005163

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	Herbaceous Forested Seep (G189)
Association (Common name)	Clay Seeps

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ELEMENT CONCEPT

Global Summary: This type is found in the northern regions of the Great Lakes in the United States. Stands occur on toeslopes, where constant seepage creates saturated clay soils. Substrate is neither mucky not peaty. Stands are often shaded (up to 90% cover) by adjacent forest types, including *Tsuga canadensis* (eastern hemlock)- and *Acer saccharum* (sugar maple)-dominated stands. Trees rarely occur in the seepage zone itself, which can be as much as 30 m wide. Characteristic plants include *Equisetum scirpoides* (dwarf scouringrush) (often dominant) and *Impatiens pallida* (pale touch-me-not). Other species in northern Wisconsin include *Cypripedium reginae* (showy lady's slipper), *Cypripedium parviflorum* (lesser yellow lady's slipper), *Equisetum arvense* (field horsetail) and, rarely, *Parnassia palustris* (marsh grass of Parnassus) and *Parnassia glauca* (fen grass of Parnassus). In southeastern Wisconsin, common species include *Gentianopsis virgata* (lesser fringed gentian), *Oligoneuron ohioense* (Ohio goldenrod), and *Triantha glutinosa* (sticky tofieldia). Other fen plants may also occur. *Epipactis helleborine* (broadleaf helleborine) is a common exotic orchid.

ENVIRONMENTAL DESCRIPTION

Apostle Islands National Lakeshore Environment: This sparsely vegetated community was sampled once at Sand Point on the mainland. The site is a steep east-facing clay bank with poorly drained clay soil. The unvegetated surface is made up entirely of leaf litter (100% cover). No evidence of disturbance was reported.

Global Environment: Stands occur on toeslopes, where constant seepage creates saturated, semi-stable clay soil bluffs. Substrate is neither mucky nor peaty. Stands are often shaded (up to 90% cover) by adjacent forest types (E. Epstein pers. comm. 1999).

VEGETATION DESCRIPTION

Apostle Islands National Lakeshore Vegetation: This community is very sparsely vegetated. The sparse (20% cover) tall-shrub layer (2-5 m) includes *Acer spicatum* (mountain maple), *Amelanchier* (serviceberry) sp., and *Betula papyrifera* (paper birch), and the sparse (20%) short-shrub (0.5-1 m) is dominated by *Diervilla lonicera* (northern bush honeysuckle) and *Rubus* (blackberry) sp. The sparse (30%) herbaceous layer includes *Aralia nudicaulis* (wild sarsaparilla), *Athyrium filix-femina* (common ladyfern), *Chamerion angustifolium* (fireweed), *Fragaria virginiana* (Virginia strawberry), and tree seedlings.

Global Vegetation: Stands are often shaded (up to 90% cover) by adjacent forest types, including *Tsuga canadensis* (eastern hemlock) and *Acer saccharum* (sugar maple) dominated stands. Trees rarely occur in the seepage zone itself, which can be as much as 30 m wide. Characteristic plants include *Equisetum scirpoides* (dwarf scouringrush) (often dominant) and *Impatiens pallida* (pale touch-me-not). Other species in northern Wisconsin include *Cypripedium reginae* (showy lady's slipper), *Cypripedium parviflorum* (lesser yellow lady's slipper), *Equisetum arvense* (field horsetail), and, rarely, *Parnassia palustris* (marsh grass of Parnassus) and *Parnassia glauca* (fen grass of Parnassus). In southeastern Wisconsin, common species include *Gentianopsis virgata* (lesser fringed gentian), *Oligoneuron ohioense* (Ohio goldenrod) and *Triantha glutinosa* (sticky tofieldia). Other fen plants may also occur. *Epipactis helleborine* (broadleaf helleborine) is a common exotic orchid (E. Epstein pers. comm. 1999).

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Aralia nudicaulis* (wild sarsaparilla), *Athyrium filix-femina* (common ladyfern), *Chamerion angustifolium* (fireweed), *Diervilla lonicera* (northern bush honeysuckle), *Fragaria virginiana* (Virginia strawberry)

OTHER NOTEWORTHY SPECIES

Apostle Islands National Lakeshore: Exotic/Invasive: *Phleum pratense* (timothy, exotic, Medium), *Poa pratensis* (Kentucky bluegrass, exotic, Medium), *Taraxacum officinale* (common dandelion, exotic)

Global: Exotic/Invasive: *Epipactis helleborine* (broadleaf helleborine, exotic, Medium/Low)

CONSERVATION STATUS RANK

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

CLASSIFICATION

Status: Standard

Classification Confidence: 3 - Weak

Global Comments: Description is based on input at Great Lakes Planning meeting workshop in Escanaba, Michigan, Dec 14-15, 1998, and further review by Eric Epstein (pers. comm. 1999) from Wisconsin and Michigan. Type may actually fit better under a forb formation (V.B.2.N.f - Saturated perennial forb vegetation). Stands occur on the Apostle Islands, the St. Louis River and tributaries in northwest Wisconsin, along Lake Michigan in Milwaukee County, and possibly in Door, Kewaunee, and Manitowoc counties. Unstable bluffs generally support a more 'weedy' flora, resembling that of the surrounding forest.

Global Related Concepts:

- Northern Wet Meadow (Chapman et al. 1989) ?

ELEMENT DISTRIBUTION

Apostle Islands National Lakeshore Range: This sparsely vegetated community was sampled at Sand Point on the mainland.

Global Range: This type is found in the northern regions of the Great Lakes in the United States, and is currently only reported from Wisconsin and Michigan.

Nations: US

States/Provinces: MI?, WI:S2

TNC Ecoregions: 48:C

USFS Ecoregions (1994/95): 212Ia:CCC, 212Ja:CPP

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Federal Lands: NPS (Apostle Islands)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (1 plot): APIS.316.
Apostle Islands National Lakeshore Map Code: N/A
Local Description Authors: M.J. Russo
Global Description Authors: D. Faber-Langendoen
References: Chapman et al. 1989, Epstein pers. comm., Midwestern Ecology Working Group n.d., 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: CEGL002562

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
Ecological System(s):	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

Apostle Islands National Lakeshore Environment: This water-lily aquatic wetland was sampled once on Stockton Island. The site is a Permanently flooded, flat lagoon with a substrate of very poorly drained sand. The unvegetated surface is entirely (100% cover) standing water.
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

Apostle Islands National Lakeshore Vegetation: This sparsely vegetated (5% cover) wetland contains floating-leaved aquatics *Brasenia schreberi* (watershield) and *Nymphaea odorata* ssp. *tuberosa* (American white waterlily) along with trace amounts of the submerged aquatic *Utricularia macrorhiza* (common bladderwort) and state-vulnerable (S3) *Eleocharis robbinsii* (Robbins' spikerush).
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	**Lifeform**	**Species**
Floating aquatic	Aquatic herb (floating & submergent)	*Nuphar lutea* ssp. *pumila* (yellow pond-lily), *Nuphar lutea* ssp. *variegata* (variegated yellow pond-lily), *Nymphaea odorata* (American white waterlily)

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CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Brasenia schreberi* (watershield), *Eleocharis robbinsii* (Robbins' spikerush), *Nymphaea odorata* ssp. *tuberosa* (American white waterlily), *Utricularia macrorhiza* (common bladderwort)
Global: *Nuphar lutea* ssp. *pumila* (yellow pond-lily), *Nuphar lutea* ssp. *variegata* (variegated yellow pond-lily), *Nymphaea odorata* (American white waterlily)

OTHER NOTEWORTHY SPECIES

Apostle Islands National Lakeshore: Vulnerable: *Eleocharis robbinsii* (Robbins' spikerush, state-vulnerable, G4G5)

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

Apostle Islands National Lakeshore Range: This water-lily aquatic wetland was sampled on Stockton Island.
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:CPP, 212Jb:CPP, 212Jc:CPP, 212Jl:CPP, 212Jn:CPP, 212Jo:CPP, 212La:CPP, 212Mb:CPP, 212Na:CPP, 212Nb:CPP, 212Nc:CPP, 221B:CC, 222Jb:CCC, 222Je:CCC, M212:C
Federal Lands: NPS (Apostle Islands, Isle Royale, Pictured Rocks, Sleeping Bear Dunes, Voyageurs); USFS (Chippewa, Huron, Huron-Manistee, Manistee?, Ottawa, Superior?)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (1 plot): APIS.204.
Apostle Islands National Lakeshore Map Code: HFA
Local Description Authors: M.J. Russo
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
Ecological System(s):	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),

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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* (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).

ENVIRONMENTAL DESCRIPTION

Apostle Islands National Lakeshore Environment: This submerged aquatic or open marsh community was sampled twice in the park, once at Little Sand Bay Lagoon on the mainland unit and once near the western end of the lagoon/bog south of the barrier beach on Michigan Island. These sites are permanently flooded, flat depressions at 182 and 189 m (596-620 feet) elevation, respectively. The water depth on Michigan Island was reported to be 0.25 to 1.5 m. The soils are very poorly drained sand and muck. The unvegetated surface is 100% standing water.

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

Apostle Islands National Lakeshore Vegetation: This is a sparse (5-50% cover) aquatic community. The dominant in one plot is the floating-leaved aquatic *Brasenia schreberi* (watershield), and the dominant in the other is the submerged aquatic *Sparganium fluctuans* (floating bur-reed). Other floating-leaved species include *Potamogeton amplifolius* (largeleaf pondweed) and *Nuphar lutea* (yellow pond-lily). Other submerged species include *Ceratophyllum demersum* (coon's-tail), *Potamogeton pusillus* ssp. *tenuissimus* (small pondweed), *Schoenoplectus subterminalis* (swaying bulrush), and several *Utricularia* (bladderwort) spp.

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).

MOST ABUNDANT SPECIES

Apostle Islands National Lakeshore

Stratum	Lifeform	Species
Floating aquatic	Aquatic herb (floating & submergent)	*Brasenia schreberi* (watershield)
Submerged aquatic	Aquatic herb (floating & submergent)	*Sparganium fluctuans* (floating bur-reed)

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CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Brasenia schreberi* (watershield), *Ceratophyllum demersum* (coon's-tail), *Nuphar lutea* (yellow pond-lily), *Potamogeton amplifolius* (largeleaf pondweed), *Potamogeton pusillus* ssp. *tenuissimus* (small pondweed), *Sparganium fluctuans* (floating bur-reed), *Utricularia cornuta* (horned bladderwort)

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

Apostle Islands National Lakeshore Range: This aquatic community was sampled Little Sand Bay Lagoon on the mainland unit and on Michigan Island.
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, Indiana Dunes, Isle Royale, Pictured Rocks, Saint Croix, Sleeping Bear Dunes, Voyageurs); USFS (Chequamegon, Chequamegon-Nicolet, Nicolet, Shawnee, Superior?)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (2 plots): APIS.017, APIS.110.
Apostle Islands National Lakeshore Map Code: HSV
Local Description Authors: M.J. Russo
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

G340. Eastern North American Lake & River Bluff [Placeholder]

Eroding Clay Bank

Eroding Clay Bank Sparse Vegetation
Eroding Clay Bank Sparse Vegetation
Identifier: CEGL002584

NVC CLASSIFICATION

Division	Eastern North American Temperate Cliff, Scree & Rock Vegetation (6.B.2.a)
Macrogroup	Eastern North American Cliff & Rock Vegetation (MG111)
Group	Eastern North American Lake & River Bluff [Placeholder] (G340)
Association (Common name)	Eroding Clay Bank

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Ecological System(s): Laurentian-Acadian Lakeshore Beach (CES201.586)
Northeastern Erosional Bluff (CES203.498)

ELEMENT CONCEPT

Global Summary: This eroding clay bank type is found localized along banks of rivers and lakes in the midwestern and northeastern United States and adjacent Canada. Stands occur on active steep and near-vertical exposures of unconsolidated clays and sands that are at least 3 m in height. Stands are subject to active erosional processes. They are typically found along lakes and rivers. Moisture and temperature fluctuations can be extreme. The vegetation is typically sparse to absent. Little information is available on species that persist in this habitat.

ENVIRONMENTAL DESCRIPTION

Apostle Islands National Lakeshore Environment: This eroding clay bank type was sampled twice in the park on Oak Island and Michigan Island. The sites are a somewhat steep, south-facing bank and steep, southeast-facing beach ridge, respectively. Soils are rapidly drained silty clay and clay. The unvegetated surface is dominated by leaf litter (0-77% cover) or bare soil (15-87%) with some large rocks (0-2%), small rocks (0-4%), and wood (6-8%). Evidence of disturbance includes severe erosion and the presence of exotic many plants.
Global Environment: This eroding clay bank type is found localized along banks of rivers and lakes in the midwestern and northeastern United States and adjacent Canada. Stands occur on active steep and near-vertical exposures of unconsolidated clays and sands that are at least 3 m in height. Moisture and temperature fluctuations can be extreme (Lee et al. 1998).

VEGETATION DESCRIPTION

Apostle Islands National Lakeshore Vegetation: This community is dominated by the moderate (60-70% cover) herbaceous layer. However, there is also a very sparse (10%) tree layer (5-10 m tall) and a sparse (10-20%) tall-shrub layer (2-5 m) that may include *Abies balsamea* (balsam fir), *Betula papyrifera* (paper birch), *Quercus rubra* (northern red oak), *Rhus typhina* (staghorn sumac), and *Thuja occidentalis* (northern white-cedar). Dominant herbs include *Calamagrostis canadensis* (bluejoint) and *Solidago canadensis* (Canada goldenrod); additional herbs include *Achillea millefolium* (common yarrow), *Danthonia spicata* (poverty oatgrass), *Elymus canadensis* (Canada wildrye), *Equisetum arvense* (field horsetail), *Solidago gigantea* (giant goldenrod), and as a result of the heavy erosion at the site, many exotic species.
Global Vegetation: The vegetation is typically sparse to absent. Little information is available on species that persist in this habitat; ruderal species tend to be common.

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Betula papyrifera* (paper birch), *Calamagrostis canadensis* (bluejoint), *Rhus typhina* (staghorn sumac), *Solidago canadensis* (Canada goldenrod), *Thuja occidentalis* (northern white-cedar)

OTHER NOTEWORTHY SPECIES

Apostle Islands National Lakeshore: Exotic/Invasive: *Cirsium arvense* (Canada thistle, exotic, High/Medium), *Cirsium vulgare* (bull thistle, exotic, Medium/Low), *Phleum pratense* (timothy, exotic, Medium), *Poa compressa* (Canada bluegrass, exotic, High/Low), *Poa pratensis* (Kentucky bluegrass, exotic, Medium), *Sonchus arvensis* ssp. *uliginosus* (moist sowthistle, exotic), *Trifolium pratense* (red clover, exotic, Low/Insignificant), *Trifolium repens* (white clover, exotic, Medium/Low), *Verbascum thapsus* (common mullein, exotic, Medium)
Global: Vulnerable: *Cicindela puritana* (puritan tiger beetle, G1G2)

CONSERVATION STATUS RANK

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

CLASSIFICATION

Status: Standard
Classification Confidence: 3 - Weak
Global Comments: This type is found along lakes and rivers, but much more rangewide information is needed to characterize this type. Its status as a natural ecological community is considered by some to be rather dubious, not because it does not occur in natural settings, but because it has been poorly characterized as an association and may include more than one type.
Global Similar Associations:
- Small Eroding Bluffs Midwestern Sparse Vegetation (CEGL002315)

ELEMENT DISTRIBUTION

Apostle Islands National Lakeshore Range: This eroding clay bank type was sampled on Oak Island and Michigan Island.
Global Range: This eroding bank type is found localized along banks of rivers and lakes in the midwestern and northeastern United States and adjacent Canada.
Nations: CA, US
States/Provinces: IN?, MA, MB:SU, MD, ME, MI, NH:S2?, ON:S4, QC, VT:S2, WI
TNC Ecoregions: 48:C, 58:C, 61:C, 63:C, 64:C
USFS Ecoregions (1994/95): 212Ea:CCP, 212Ec:CCP, 212Ed:CCP, 212Ee:CCP, 212Hi:CCC, 212Ia:CCC, 222:?
Federal Lands: NPS (Apostle Islands, Pictured Rocks)

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ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (2 plots): APIS.030, APIS.114.
Apostle Islands National Lakeshore Map Code: VEB
Local Description Authors: M.J. Russo
Global Description Authors: D. Faber-Langendoen, mod. S.C. Gawler
References: Greenall 1996, Lee et al. 1998, Midwestern Ecology Working Group n.d., Rawinski 1984, Sperduto and Nichols 2004, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000

G341. Great Lakes Cliff & Shore [Placeholder]

Great Lakes Sandstone Bedrock Shore

Sandstone Bedrock Great Lakes Shore Sparse Vegetation
Sandstone Bedrock Great Lakes Shore Sparse Vegetation
Identifier: CEGL002507

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 Sandstone Bedrock Shore
Ecological System(s):	Great Lakes Acidic Rocky Shore and Cliff (CES201.025)

ELEMENT CONCEPT

Global Summary: This sparsely vegetated sandstone bedrock rocky shore community is found on the shores of Lake Superior in the United States and Canada. They occur as small inclusions within areas of the larger sandstone cliff communities. Narrow areas of pavement occur at less than a meter above the lake levels and are generally moist. Mosses, liverworts, and scattered vascular plants may be found. Vascular plants on the pavement are concentrated in cracks in the rock, whereas mosses and liverworts are found where seepages flow across the rock. Some of the more common vascular plants include *Achillea millefolium* (common yarrow), *Chamerion angustifolium* (fireweed), *Betula papyrifera* (paper birch), *Campanula rotundifolia* (bluebell bellflower), *Cystopteris fragilis* (brittle bladderfern), *Deschampsia caespitosa* (tufted hairgrass), *Phegopteris connectilis* (long beechfern), *Alnus incana* (gray alder), *Equisetum arvense* (field horsetail), and *Euthamia graminifolia* (flat-top goldentop). Less common, and more restricted to cracks in the pavement, are *Sibbaldiopsis tridentata* (shrubby fivefingers), *Lobelia kalmii* (Ontario lobelia), *Packera indecora* (elegant groundsel), *Packera paupercula* (balsam groundsel), *Physocarpus opulifolius* (common ninebark), *Primula mistassinica* (Mistassini primrose), *Trisetum spicatum* (spike trisetum), and *Rubus pubescens* (dwarf red blackberry).

ENVIRONMENTAL DESCRIPTION

Apostle Islands National Lakeshore Environment: This sparsely vegetated lakeshore community was sampled at three locations in the park: Bear Island (1 site), Outer Island near Lullaby Logging Camp (1), and Sand Island (1). The sites are flat to gentle south- and southeast-facing lake terraces from about 2-10 m above the lake level. Elevations range from 186 to 210 m (611-690 feet). The substrate is rapidly drained bedrock which dominates (55-99% cover) the unvegetated surface. One plot had 35% cover of standing water. Evidence of disturbance includes damage due to high waves and shore ice and remains from the old logging camp.
Global Environment: In Michigan, these bedrock shorelines occur as small inclusions within areas of the larger sandstone cliff communities. Narrow areas of pavement occur at less than a meter above the lake levels and are generally moist (Albert et al. 1995).

VEGETATION DESCRIPTION

Apostle Islands National Lakeshore Vegetation: What little vegetation there is occurs in cracks and crevices within the bedrock. There may be a sparse (5% cover) short-shrub layer (0.5-1 m tall) with the sparse (5-10%) herbaceous layer. Shrubs include *Diervilla lonicera* (northern bush honeysuckle), *Spiraea alba* (white meadowsweet) and *Physocarpus opulifolius* (common ninebark). The herb layer may contain tree seedlings, *Agrostis hyemalis* (winter bentgrass), *Calamagrostis canadensis* (bluejoint), *Campanula rotundifolia* (bluebell bellflower), *Euthamia graminifolia* (flat-top goldentop), *Fragaria virginiana* (Virginia strawberry), *Hieracium kalmii* (Kalm's hawkweed), *Lobelia kalmii* (Ontario lobelia), *Osmunda claytoniana* (interrupted fern), and *Solidago canadensis* (Canada goldenrod). Nonvascular species (mosses and lichens) cover 5-60% of the bedrock surface.
Global Vegetation: This community is dominated by nonvascular species with open pavement. Mosses, liverworts, and scattered vascular plants may be found. Vascular plants on the pavement are concentrated in cracks in the rock, whereas mosses and liverworts are found where seepages flow across the rock. Some of the more common vascular plants include *Achillea millefolium* (common yarrow), *Chamerion angustifolium* (fireweed), *Betula papyrifera* (paper birch), *Campanula rotundifolia* (bluebell bellflower), *Cystopteris fragilis* (brittle bladderfern), *Deschampsia caespitosa* (tufted hairgrass), *Phegopteris connectilis* (long beechfern), *Alnus incana* (gray alder), *Equisetum arvense* (field horsetail), and *Euthamia graminifolia* (flat-top goldentop). Less common, and more restricted to cracks in the pavement, are *Sibbaldiopsis tridentata* (shrubby fivefingers), *Lobelia kalmii* (Ontario lobelia), *Packera indecora* (elegant groundsel), *Packera paupercula* (balsam groundsel), *Physocarpus opulifolius* (common ninebark), *Primula mistassinica* (Mistassini primrose), *Trisetum spicatum* (spike trisetum), and *Rubus pubescens* (dwarf red blackberry) (Albert et al. 1995).

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CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Agrostis hyemalis* (winter bentgrass), *Campanula rotundifolia* (bluebell bellflower), *Diervilla lonicera* (northern bush honeysuckle), *Euthamia graminifolia* (flat-top goldentop), *Spiraea alba* (white meadowsweet)

OTHER NOTEWORTHY SPECIES

Apostle Islands National Lakeshore: Exotic/Invasive: *Poa compressa* (Canada bluegrass, exotic, High/Low), *Poa pratensis* (Kentucky bluegrass, exotic, Medium), *Taraxacum officinale* (common dandelion, exotic)

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G4 (24-Oct-2002). This sandstone bedrock shore community is found in a relatively restricted distribution on the shores of Lake Superior in the United States and Canada. They occur as small inclusions within areas of the larger sandstone cliff communities. Narrow areas of pavement occur at less than a meter above the lake levels and are generally moist. States and provinces that contain this type have yet to provide much information on it. More information on the status of this type is needed.

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Global Comments: Distribution in Minnesota is uncertain.
Global Similar Associations:

- Granite - Metamorphic Bedrock Great Lakes Shore Sparse Vegetation (CEGL005216)--This is also a non-alkaline shoreline type, but composed of granite/metamorphic bedrock.
- Non-alkaline Cobble - Gravel Great Lakes Shore Sparse Vegetation (CEGL002508)--cobble-gravel type.

Global Related Concepts:

- Bedrock Beach - Sandstone Cliff/Lakeshore (Chapman et al. 1989) B

ELEMENT DISTRIBUTION

Apostle Islands National Lakeshore Range: This sparsely vegetated lakeshore community occurs on Bear, Outer, and Sand islands.
Global Range: This sparsely vegetated sandstone bedrock rocky shore community is found in the United States and Canada on the Michigan, Wisconsin (Apostle Islands only), and Ontario shores of Lake Superior, and possibly in Minnesota.
Nations: CA, US
States/Provinces: MI, MN, ON, WI:S1
TNC Ecoregions: 48:C
USFS Ecoregions (1994/95): 212Ha:CCP, 212Hi:CCC, 212Ia:CPP, 212Ja:CPP, 212Jb:CPP, 212Jn:CPP, 212Jr:CPP, 212Lb:C??
Federal Lands: NPS (Apostle Islands, Pictured Rocks); USFS (Hiawatha)

ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (3 plots): APIS.123, APIS.141, APIS.319.
Apostle Islands National Lakeshore Map Code: VBS
Local Description Authors: M.J. Russo
Global Description Authors: D. Faber-Langendoen
References: Albert et al. 1995, Chapman et al. 1989, Midwestern Ecology Working Group n.d., WNHIP unpubl. data

Great Lakes Shore Sandstone Cliff

Sandstone Great Lakes Shore Cliff Sparse Vegetation
Sandstone Great Lakes Shore Cliff Sparse Vegetation
Identifier: CEGL002503

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 Shore Sandstone Cliff
Ecological System(s):	Great Lakes Acidic Rocky Shore and Cliff (CES201.025)

ELEMENT CONCEPT

Global Summary: This sandstone cliff community is found in the northern Great Lakes shorelines of the United States and Canada. The substrate is Precambrian sandstone, which in Michigan is exposed along the southern shoreline of Lake Superior. Cliffs rise up over 50 m in places. Species composition varies somewhat, depending on sandstone type, but sandstone cliffs are very low in botanical diversity for a variety of reasons, including lack of soil for rooting, droughtiness on much of the rock surface, exposure to waves and ice, and in some places, unstable surface prone to wave erosion. Some portions of the cliff are moist from small streams or seepages. Jacobsville sandstone has cliff faces that are largely unvegetated, with mosses, lichens, and herbs concentrated in seeps and streams. Two common herbs are *Sagina procumbens* (birdeye pearlwort) and *Stellaria calycantha* (northern starwort). *Pinguicula vulgaris* (common butterwort) also grows on moist cliffs.

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ENVIRONMENTAL DESCRIPTION

Apostle Islands National Lakeshore Environment: This sandstone cliff community was sampled twice on the eastern and western sides of Devils Island. The sites are on flat to gently sloping cliffs. The unvegetated surface is made up almost entirely of bedrock (90-95% cover) with some standing water (5-10%); temporary pools form after storms and rain events.
Global Environment: The substrate is Precambrian sandstone, which in Michigan is exposed along the southern shoreline of Lake Superior. Cliffs rise up over 50 m in places. Fog and wavespray are important environmental influences (Albert et al. 1995).

VEGETATION DESCRIPTION

Apostle Islands National Lakeshore Vegetation: What little vegetation there is occurs in cracks and crevices within the bedrock. There may be a sparse (5% cover) short-shrub layer (0.5-1 m tall) with the sparse (5%) herbaceous layer. Shrubs include traces of *Alnus viridis* ssp. *crispa* (mountain alder), *Betula papyrifera* (paper birch), *Cornus sericea* (red-osier dogwood), *Populus balsamifera* (balsam poplar), *Populus tremuloides* (quaking aspen), and *Sorbus decora* (northern mountain-ash). The herb layer may contain tree seedlings, *Calamagrostis stricta* ssp. *inexpansa* (northern reedgrass), *Euthamia graminifolia* (flat-top goldentop), *Fragaria virginiana* (Virginia strawberry), *Lobelia kalmii* (Ontario lobelia), *Lycopodiella inundata* (inundated clubmoss), *Onoclea sensibilis* (sensitive fern), *Osmunda claytoniana* (interrupted fern), *Scirpus cyperinus* (woolgrass), and *Viola macloskeyi* (small white violet). State-vulnerable (S3) *Calamagrostis stricta* ssp. *inexpansa* (northern reedgrass) and *Primula mistassinica* (Mistassini primrose) were recorded in the sampled plots.
Global Vegetation: Species composition varies somewhat, depending on sandstone type, but sandstone cliffs are very low in botanical diversity for a variety of reasons, including lack of soil for rooting, droughtiness on much of the rock surface, exposure to waves and ice, and in some places, unstable surface prone to wave erosion. Some portions of the cliff are moist from small streams or seepages. Jacobsville sandstone has cliff faces that are largely unvegetated, with mosses, lichens, and herbs concentrated in seeps and streams. Two common herbs are *Sagina procumbens* (birdeye pearlwort) and *Stellaria calycantha* (northern starwort). *Pinguicula vulgaris* (common butterwort) also grows on moist cliffs (Albert et al. 1995).

CHARACTERISTIC SPECIES

Apostle Islands National Lakeshore: *Alnus viridis* ssp. *crispa* (mountain alder), *Betula papyrifera* (paper birch), *Calamagrostis stricta* ssp. *inexpansa* (northern reedgrass), *Cornus sericea* (red-osier dogwood), *Euthamia graminifolia* (flat-top goldentop), *Fragaria virginiana* (Virginia strawberry), *Lobelia kalmii* (Ontario lobelia), *Lycopodiella inundata* (inundated clubmoss), *Onoclea sensibilis* (sensitive fern), *Osmunda claytoniana* (interrupted fern), *Populus balsamifera* (balsam poplar), *Populus tremuloides* (quaking aspen), *Primula mistassinica* (Mistassini primrose), *Scirpus cyperinus* (woolgrass), *Sorbus decora* (northern mountain-ash), *Viola macloskeyi* (small white violet)

OTHER NOTEWORTHY SPECIES

Apostle Islands National Lakeshore: Vulnerable: *Calamagrostis stricta* ssp. *inexpansa* (northern reedgrass, state-vulnerable, G5T5), *Pinguicula vulgaris* (common butterwort, state-imperiled); *Primula mistassinica* (Mistassini primrose, state-vulnerable, G5); **Exotic/Invasive**: *Taraxacum officinale* (common dandelion, exotic)

CONSERVATION STATUS RANK

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

CLASSIFICATION

Status: Standard
Classification Confidence: 2 - Moderate
Global Comments: Categories of moist versus dry are difficult to apply due to variability on the rock surface and the Great Lakes shoreline context. Instead, substrate type is used, with the granite - metamorphic cliffs placed in Granite - Metamorphic Great Lakes Shore Cliff Sparse Vegetation (CEGL005244).
Global Similar Associations:
- Granite - Metamorphic Great Lakes Shore Cliff Sparse Vegetation (CEGL005244)

Global Related Concepts:
- Moist Acid Cliff (Chapman et al. 1989) B

ELEMENT DISTRIBUTION

Apostle Islands National Lakeshore Range: This sandstone cliff community was sampled on Devils Island.
Global Range: This sandstone cliff community type is found in the northern Great Lakes shorelines of the United States and Canada, from Michigan and Wisconsin (Apostle Islands, northern Bayfield County along Lake Superior) to Ontario, possibly eastward to Pennsylvania.
Nations: CA, US
States/Provinces: MI, ON, PA?, WI
TNC Ecoregions: 48:C
USFS Ecoregions (1994/95): 212Ha:CCC, 212He:CCP, 212Hi:CCC, 212Hl:CCC, 212Ia:CCC, 212Ib:CCC, 212Ja:CCC, 212Jb:CCP, 212Jn:CCC, 212Jr:CCC, 212Lb:C??, 222:?
Federal Lands: NPS (Apostle Islands, Pictured Rocks); USFS (Hiawatha)

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ELEMENT SOURCES

Apostle Islands National Lakeshore Plots: (2 plots): APIS.213, APIS.214.
Apostle Islands National Lakeshore Map Code: VSC
Local Description Authors: M.J. Russo
Global Description Authors: D. Faber-Langendoen
References: Albert et al. 1995, Chapman et al. 1989, Midwestern Ecology Working Group n.d., WNHIP unpubl. Data

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Appendix C: Field Key to Vegetation Types

Explanation and Use of the Field Key

This is a field key to natural vegetation types of Apostle Islands National Lakeshore (APIS). The vegetation types are based on the National Vegetation Classification Standard (NVCS) and were derived from field data collected during the APIS 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 Community Global Element code is given, followed by the association name. A few association names have an additional name listed in parenthesis following it. These correlate to map-class phases.

For best results, all assessments of vegetation types in the field should be done on an area of 5,000 m^2 (e.g., 40-m radius around point) and within a single vegetation type. Appendix B: Descriptions of Vegetation Types is recommended to complement this key to ascertain correct assessment of types.

The term dominance means greater than 60% cover unless otherwise noted. 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.

GENERAL KEY

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

WETLANDS. Presence of standing water. Saturated mineral soil, or peat soil. 39

UPLANDS

1A. Well-drained soils. 2

1B. Poorly drained soils. Canopy dominated by black ash (*Fraxinus nigra*), northern white-cedar (*Thuja occidentalis*), eastern hemlock (*Tsuga canadensis*), birch (*Betula* spp.), and/or red maple (*Acer rubrum*). 35

2A. Total canopy cover of trees >10%. 3

2B. Total canopy cover of trees <10%. 29

3A. Total canopy cover of trees <60%. Sparse, open canopy dominated by scattered jack pine (*Pinus banksiana*), red pine (*Pinus resinosa*) and/or eastern white pine (*Pinus strobus*) without an oak component. Found on beach ridges and dunes. **[CEGL005125] *Pinus banksiana* - (*Pinus resinosa*) - *Pinus strobus* / *Juniperus horizontalis* Wooded Herbaceous Vegetation**

Note: Total canopy cover of trees 10–25% is barrens phase and 25–60% is woodland phase.

3B. Total canopy cover of trees >60%. 4

4A. Tree canopy <25% conifers. 5

4B. Tree canopy >25% conifers. 13

5A. Canopy dominated by sugar maple (*Acer saccharum*), yellow birch (*Betula alleghaniensis*), northern red oak (*Quercus rubra*), northern pin oak (*Quercus ellipsoidalis*), bur oak (*Quercus macrocarpa*), and/or American basswood (*Tilia americana*). 6

5B. Canopy dominated by aspen (*Populus* spp.) and/or paper birch (*Betula papyrifera*). 10

6A. Canopy dominated by sugar maple (*Acer saccharum*), yellow birch (*Betula alleghaniensis*), and/or American basswood (*Tilia americana*). Red oak (*Quercus rubra*) <40% cover in canopy. 7

6B. Canopy dominated by oak species, including northern red oak (*Quercus rubra*), northern pin oak (*Quercus ellipsoidalis*), bur oak (*Quercus macrocarpa*). 9

7A. Canopy dominated by sugar maple (*Acer saccharum*) and/or yellow birch (*Betula alleghaniensis*). 8

7B. Canopy >20% American basswood (*Tilia americana*). **[CEGL002458] *Acer saccharum* - *Tilia americana* / *Ostrya virginiana* / *Lonicera canadensis* Forest**

8A. Yellow birch (*Betula alleghaniensis*) is >90% of canopy and sugar maple (*Acer saccharum*) <5% of canopy cover. **[CEGL005245] *Betula alleghaniensis* - (*Acer saccharum, Picea glauca*) Forest [Provisional]**

8B. Tree canopy dominated by deciduous species, particularly sugar maple (*Acer saccharum*), yellow birch (*Betula alleghaniensis*), and/or American basswood (*Tilia americana*). American basswood <20% in canopy. Most common northern hardwood type at Apostle Islands National Lakeshore. [**CEGL002457] *Acer saccharum* - *Betula alleghaniensis* - (*Tilia americana*) Forest**

9A. Canopy >40% northern red oak (*Quercus rubra*). May be found with or without significant sugar maple (*Acer saccharum*). Not common in Apostle Islands National Lakeshore. **[CEGL002461] *Quercus rubra* - *Acer saccharum* Forest**

9B. Canopy dominated by northern pin oak (*Quercus ellipsoidalis*) and/or bur oak (*Quercus macrocarpa*). Not common in Apostle Islands National Lakeshore. **[CEGL002077] *Quercus ellipsoidalis* - (*Quercus macrocarpa*) Forest**

10A. Canopy 10–25% northern hardwood species such as maple (*Acer* spp.) and yellow birch (*Betula alleghaniensis*). 11

10B. Canopy contains little to no northern hardwood species. 12

11A. Quaking aspen (*Populus tremuloides*) and paper birch (*Betula papyrifera*) >75% in T2 canopy (not supercanopy) with minor component of northern hardwoods. Paper birch <90% canopy cover. **[CEGL002468] *Populus tremuloides - Betula papyrifera* / *Acer saccharum* - Mixed Hardwoods Forest**

11B. Dominated by paper birch (*Betula papyrifera*) and red maple (*Acer rubrum*), quaking aspen (*Populus tremuloides*) less frequent. Found only as deciduous shrub and tree stringers along sand ridges and lagoons. Not common at Apostle Islands National Lakeshore. [**CEGL002467] *Populus tremuloides - Betula papyrifera* - (*Acer rubrum, Populus grandidentata*) Forest**

12A. Canopy dominated by aspen (*Populus* spp.) or paper birch (*Betula papyrifera*, <90% cover). Typically contains balsam fir (*Abies balsamea*) and/or white spruce (*Picea glauca*) in the shrub or subcanopy. **[CEGL002466] *Populus tremuloides - Betula papyrifera* / (*Abies balsamea, Picea glauca*) Forest**

12B. Canopy >90% paper birch (Betula papyrifera). **[CEGL002463] *Betula papyrifera* / *Diervilla lonicera* - (*Abies balsamea*) Forest**

13A. Red pine (*Pinus resinosa*), eastern white pine (*Pinus strobes*), and/or jack pine (*Pinus banksiana*) dominant conifers in canopy. 14

13B. Non-pine conifers dominate canopy including black spruce (*Picea mariana*), northern white-cedar (*Thuja occidentalis*), balsam fir (*Abies balsamea*), and/or eastern hemlock (*Tsuga canadensis*). 23

14A. Tree canopy cover and basal area codominated by a mixture of pine species (*Pinus* spp.). Occurs ONLY on dunes and sand ridges. Includes pine-dominated stringers along lagoons and dune ridges. **[CEGL002589] *Pinus banksiana - Pinus resinosa - Pinus strobus* Dune Forest**

Note: Compare with *Pinus banksiana* - (*Pinus resinosa*) - *Pinus strobus* / *Juniperus horizontalis* Wooded Herbaceous Vegetation (CEGL005125)

14B. Tree canopy cover and basal area dominated by one or more pine species (*Pinus* spp.) and occurs outside dunes, sand ridges, and stringers along lagoons and dune ridges. 15

15A. Jack pine (*Pinus banksiana*) is dominant pine. Red pine (*Pinus resinosa*) or eastern white pine (*Pinus strobus*) may be present but <25% canopy cover. 16

15B. Red pine (*Pinus resinosa*) and/or eastern white pine (*Pinus strobus*) dominate. Jack pine (*Pinus banksiana*) may be present but <25%. 18

16A. >25% cover of deciduous species in canopy. **[CEGL002441] *Pinus banksiana* / *Vaccinium* spp. / *Pleurozium schreberi* Forest**

16B. >25% cover of deciduous species in canopy. 17

17A. Northern hardwoods—including paper birch, red maple, and quaking aspen (*Betula papyrifera, Acer rubrum,* and *Populus tremuloides*)—dominate the deciduous component of the canopy. This type is uncommon in Apostle Islands National Lakeshore. **[CEGL002518] *Pinus banksiana* - *Populus tremuloides* / *Diervilla lonicera* Forest**

17B. Pin oak (*Quercus ellipsoidalis*) dominates the deciduous component of the canopy. Aspen (*Populus* spp.) in canopy <25% cover. This type is uncommon in Apostle Islands National Lakeshore. **[CEGL002478] *Pinus banksiana* - (*Pinus resinosa*) - *Quercus ellipsoidalis* / *Carex pensylvanica* Forest**

18A. Red pine (*Pinus resinosa*) >75% cover compared to other conifers in canopy; <25% eastern white pine (*Pinus strobus*) in canopy. 19

18B. Eastern white pine (*Pinus strobes*) >25% of conifers. 20

19A. <25% hardwoods in canopy. **[CEGL002443] *Pinus resinosa* / *Vaccinium* spp. Forest**

19B. >25% hardwoods in canopy. **[CEGL002520] *Pinus resinosa* - *Populus tremuloides* / *Diervilla lonicera* - *Vaccinium* spp. Forest**

20A. Eastern white pine (*Pinus strobus*) and eastern hemlock (*Tsuga canadensis*) both >25% in canopy and may have significant hemlock in subcanopy. Eastern white pine can be less dominant than hemlock and may comprise the supracanopy. **[CEGL002590] *Pinus strobus* - *Tsuga canadensis* Great Lakes Forest**

20B. Eastern hemlock <25% of canopy. 21

21A. Canopy >25% hardwoods—aspen (*Populus* spp.) and/or paper birch (*Betula papyrifera*). **[CEGL002479] *Pinus strobus* - *Populus tremuloides* / *Corylus cornuta* Forest**

21B. Canopy <25% hardwoods—aspen (*Populus* spp.) and/or paper birch (*Betula papyrifera*). 22

22A. Found mostly on sandscapes and contains little to no shrub layer (<5% cover of shrubs). **[CEGL002444] *Pinus strobus* / *Vaccinium* spp. Forest**

22B. Found mostly on bedrock. Mesic with significant shrub layer. **[CEGL002445] *Pinus strobus* / *Acer spicatum* - *Corylus cornuta* Forest**

23A. Black spruce (*Picea mariana*) dominates canopy with <25% deciduous trees. Red pine can be present but <75%. **[CEGL002447] *Picea mariana* / *Pleurozium schreberi* Forest**

23B. Tree canopy dominated by northern white-cedar (*Thuja occidentalis*), balsam fir (*Abies balsamea*) and/or eastern hemlock (*Tsuga canadensis*). 24

24A. Balsam fir (*Abies balsamea*) <50% of canopy. Northern white-cedar (*Thuja occidentalis*) and/or eastern hemlock (*Tsuga canadensis*) >25%. 25

24B. Balsam fir (*Abies balsamea*) >50% in uppermost canopy. Other conifer species each <25% in canopy. 28

25A. Northern white-cedar (*Thuja occidentalis*) dominant conifer in canopy. 26

25B. Eastern hemlock (*Tsuga canadensis*) dominant conifer in canopy or subcanopy just below other trees overtopping it slightly. 27

26A. <25% deciduous component in canopy **[CEGL002449] *Thuja occidentalis* / *Abies balsamea* - *Acer spicatum* Forest (conifer phase)** Note: Compare to *Thuja occidentalis* - (*Picea mariana*, *Abies balsamea*) / *Alnus incana* Forest (CEGL002456). This type should be more mesic, but can grade into CEGL002456

26B. >25% deciduous component in canopy. **[CEGL002449] *Thuja occidentalis* / *Abies balsamea* - *Acer spicatum* Forest (conifer - hardwood phase)**

27A. <25% deciduous in canopy. **[CEGL002598] *Tsuga canadensis* - (*Betula allegheniensis*) Forest**

Note: Compare with *Pinus strobus* - *Tsuga canadensis* Great Lakes Forest (CEGL002590). CEGL002598 should have little to no eastern white pine (*Pinus strobes*).

Note: Compare with *Tsuga canadensis* - *Betula alleghaniensis* Saturated Forest (CEGL005003), which can be inclusion to this type.

27B. >25% deciduous in canopy. **[CEGL005044] *Tsuga canadensis* - *Acer saccharum* - *Betula allegheniensis* Forest**

28A. Paper birch (*Betula papyrifera*) and other deciduous species <25% cover in canopy. **[CEGL002474] *Abies balsamea* - *Betula papyrifera* / *Diervilla lonicera* Forest (conifer phase)**

28B. Paper birch (*Betula papyrifera*), or rarely red maple (*Acer rubrum*) codominates with balsam fir (*Abies balsamea*). **[CEGL002474] *Abies balsamea* - *Betula papyrifera* / *Diervilla lonicera* Forest Mixed (conifer - hardwood phase)**

29A. Overall vegetation cover >10%. 30

29B. Overall vegetation cover <10%. 32

30A. Dominated by herbaceous species, particularly American beachgrass (*Ammophila breviligulata*) and/or little bluestem (*Schizachyrium scoparium*). Shrubs and dwarf-shrubs <25% cover. Found mostly on beaches and sandscapes. **[CEGL005098] *Ammophila breviligulata* - (*Schizachyrium scoparium*) Herbaceous Vegetation**

30B. Dwarf-shrubs >25% absolute cover. 31

31A. Dwarf-shrubs dominated by juniper (*Juniperus* spp.) and/or bearberry (*Arctostaphylos uva-ursi*). **[CEGL005064] *Juniperus horizontalis - Arctostaphylos uva-ursi - Juniperus communis* Dune Dwarf-shrubland**

31B. Dwarf-shrubs dominated by woolly beach-heather (*Hudsonia tomentosa*). **[CEGL004024] *Hudsonia tomentosa* Dune Dwarf-shrubland**

32A. Underlying substrate is sandstone. 33

32B. Underlying substrate is clay. 34

33A. Sandstone ledge cliffs along margins of islands and mainland. Elevated above Lake Superior. May have inclusions of Sandstone Bedrock Great Lakes Shore Sparse Vegetation (CEGL002507). **[CEGL002503] Sandstone Great Lakes Shore Cliff Sparse Vegetation**

33B. Sandstone bedrock ledges along edges of islands and mainland near waters (within 3 m of lake elevation). May have inclusions of Sandstone Great Lakes Shore Cliff Sparse Vegetation (CEGL002503). **[CEGL002507] Sandstone Bedrock Great Lakes Shore Sparse Vegetation**

34A. Tiny seeps on slopes. May be shaded by nearby forests. Can contain sparse vegetation with species including water horsetail (*Equisetum* spp.), lady's slipper (*Cypripedium* spp.), Parnassus (*Parnassia* spp.), and/or pale touch-me-not (*Impatiens pallida*). **[CEGL005163] Clay Seeps Sparse Vegetation**

34B. Eroding embankments along island edges above shoreline. Sparsely vegetated. Occasionally vegetation may be >10%, but rarely. **[CEGL002584] Eroding Clay Bank Sparse Vegetation**

35A. Deciduous species <25% of canopy cover. 36

35B. Deciduous species >25% of canopy cover. 37

36A. Eastern hemlock (*Tsuga canadensis*) >25% of canopy. Northern white-cedar (*Thuja occidentalis*) must be <50% compared to eastern hemlock. **[CEGL005003] *Tsuga canadensis* - *Betula alleghaniensis* Saturated Forest**

Note: Can be an inclusion within the *Tsuga canadensis* - (*Betula alleghaniensis*) Forest (CEGL002598).

36B. Northern white-cedar (*Thuja occidentalis*) >50% of canopy compared to eastern hemlock (*Tsuga canadensis*) and all other conifers. May contain dense shrub layer of gray alder (*Alnus incana*). **[CEGL002456] *Thuja occidentalis* - (*Picea mariana, Abies balsamea*) / *Alnus incana* Forest**

Note: Compare to *Thuja occidentalis* / *Abies balsamea* - *Acer spicatum* Forest (CEGL002449). CEGL002456 should be saturated, but can grade into CEGL002449.

37A. Canopy dominated by red maple (*Acer rubrum*) and/or birch (*Betula* spp.). Black ash (*Fraxinus nigra*) <25%. **[CEGL002071] *Acer rubrum* - *Fraxinus* spp. - *Betula papyrifera* / *Cornus canadensis* Forest**

Note: This type can occur in beaver complex areas.

37B. Black ash (*Fraxinus nigra*) >25% cover of canopy. 38

38A. Northern white-cedar (*Thuja occidentalis*) >25% cover and codominant with black ash (*Fraxinus nigra*). Northern white-cedar may be overtopped by taller deciduous trees and may only occur in subcanopy. **[CEGL005165] *Thuja occidentalis* - *Fraxinus nigra* Forest**

38B. *Thuja occidentalis* <25% in canopy and/or subcanopy. **[CEGL002105] *Fraxinus nigra* - Mixed Hardwoods - Conifers / *Cornus sericea* / *Carex* spp. Forest**

WETLANDS

39A. Non-peatland wetlands, *Sphagnum* spp. <25% cover. 40

39B. Peatland wetlands, *Sphagnum* spp. >25% cover. 48

40A. Not permanently flooded. Or, if permanently flooded, then standing water ≤0.5 m deep. 41

40B. Permanently flooded. Standing water ≥0.5 m deep. 45

41A. Total canopy cover of trees >25%. 35

41B. Total canopy cover of trees <25%. 42

42A. Total shrub cover >25%. Gray alder (*Alnus incana*) >25% shrub cover. **[CEGL002381] *Alnus incana* Swamp Shrubland**

Note: Compare with *Alnus incana* - *Salix* spp. - *Betula pumila* / *Chamaedaphne calyculata* Shrubland (CEGL005227), which only occurs in shorefen areas and has a peat layer associated with it.

42B. Total shrub cover <25%. Graminoid- or herb-dominated. 43

43A. Community dominated by Canada bluejoint (*Calamagrostis canadensis),* reed canarygrass (*Phalaris arundinacea),* and/or sedges (*Carex* spp.). 44

43B. No clear dominant herbaceous species. Obvious indication of beaver or anthropogenic disturbance. **Wet Meadow Mixed Herbaceous (Map Class; Macrogroup G112)**

44A. Community has >25% cover of Canada bluejoint (*Calamagrostis canadensis*) and/or reed canarygrass (*Phalaris arundinacea)* compared to sedges (*Carex* spp.). **[CEGL005174] *Calamagrostis canadensis* - *Eupatorium maculatum* Herbaceous Vegetation**

44B. Community has <25% cover of Canada bluejoint (*Calamagrostis canadensis*) compared to sedges (*Carex* spp.). Bulrushes (*Schoenoplectus* spp.) may be common. **[CEGL002257] *Carex* (*rostrata, utriculata*) - *Carex lacustris* - (*Carex vesicaria*) Herbaceous Vegetation**

45A. Dominated by sedges (*Carex* spp.), water horsetail (*Equisetum* spp.), white beaksedge (*Rhynchospora fusca*), Robbins' spikerush (*Eleocharis robbinsii*). 46

45B. Dominated by floating aquatic American white waterlily (*Nymphaea odorata*) and/or yellow pond-lily (*Nuphar lutea*), or submergent coon's tail (*Ceratophyllum demersum*), pondweed (*Potamogeton* spp.), watermilfoil (*Myriophyllum* spp.) vegetation. 47

45C. No clear dominant herbaceous species. Obvious indication of beaver or anthropogenic disturbance. **Wet Meadow Mixed Herbaceous (Map Class; Macrogroup G112)**

46A. Dominated by sedges (*Carex* spp.), in particular woollyfruit sedge (*Carex lasiocarpa*), though some areas dominated by coastal sedge (*Carex exilis*). **[CEGL005229] *Carex lasiocarpa* - (*Carex rostrata*) - *Equisetum fluviatile* Herbaceous Vegetation**

Note: This is a shorefen and should occur in that type of setting. May complex with *Carex* (*rostrata, utriculata*) - *Carex lacustris* - (*Carex vesicaria*) Herbaceous Vegetation (CEGL002257)

46B. Dominated by Robbins' spikerush (*Eleocharis robbinsii*). White beaksedge (*Rhynchospora fusca*), and other obligate wetland species. Little to no sedges (*Carex* spp.). May contain watershield (*Brasenia schreberi*) or yellow pond-lily (*Nuphar lutea*). **Interdunal Wetland**

Note: Found only as Interdunal wetlands on Stockton Island tombolo.

47A. Floating aquatics such as American white waterlily (*Nymphaea odorata*) and yellow pond-lily (*Nuphar lutea*) >25% cover with little to no submergent vegetation. **[CEGL002562] *Nymphaea odorata* - *Nuphar lutea* (ssp. *pumila*, ssp. *variegata*) Herbaceous Vegetation**

47B. Dominated by submergent vegetation (*Ceratophyllum demersum*, *Potamogeton* spp., *Myriophyllum* spp.) with little to no floating aquatic species present. **[CEGL002282] *Potamogeton* spp. - *Ceratophyllum* spp. Midwest Herbaceous Vegetation**

48A. Total shrub cover >25% AND total canopy cover of trees <25% cover. 49

48B. Total canopy cover of trees >25%. Woodland or forest physiognomy. 52

49A. Gray alder (*Alnus incana*), willow (*Salix* spp.), and/or bog birch (*Betula pumila*) >25% absolute cover. 50

49B. Dominated by leatherleaf (*Chamaedaphne calyculata*) and/or sweetgale (*Myrica gale*). 51

50A. Gray alder (*Alnus incana*) dominates. Occurs mostly in basins and does not occur along shoreline (shorefen) situations. **[CEGL002381] *Alnus incana* Swamp Shrubland**

50B. Dominated by gray alder (*Alnus incana*) and/or willow (*Salix* spp.). Occurs in shoreline (shorefen) situations or areas with significant lake or stream influence. **[CEGL005227] *Alnus incana* - *Salix* spp. - *Betula pumila* / *Chamaedaphne calyculata* Shrubland**

51A. Dominated by *Chamaedaphne calyculata* and/or *Myrica gale*. Occurs mostly in basins and does not occur along shoreline (shorefen) situations. **[CEGL005277] *Chamaedaphne calyculata* / *Carex oligosperma* / *Sphagnum* spp. Poor Fen Dwarf-shrubland**

51B. Occurs in shoreline (shorefen) situations or areas with woollyfruit sedge (*Carex lasiocarpa*) or coastal sedge (*Carex exilis*) as the dominant sedge. **[CEGL005228] *Chamaedaphne calyculata* - *Myrica gale* / *Carex lasiocarpa* Dwarf-shrubland**

52A. Tamarack (*Larix laricina*) present >25% cover. 53

52B. Tamarack (*Larix laricina*) absent or present <25% cover. Dominated by black spruce (*Picea mariana*) and/or northern white-cedar (*Thuja occidentalis*). 54

53A. Dominated by tamarack (*Larix laricina*). Other conifers <25% cover. Gray alder (*Alnus incana*) >5% cover. **[CEGL002471] *Larix laricina* / *Alnus incana* Forest**

53B. Dominated by mixture of tamarack (*Larix laricina*) and other conifers—black spruce (*Picea mariana*), northern white-cedar (*Thuja occidentalis*). Other conifers <25% cover. Gray alder (*Alnus incana*) <5% cover. **[CEGL005271] *Picea mariana* - (*Larix laricina*) / *Ledum groenlandicum* / *Sphagnum* spp. Forest (tamarack phase)**

54A. Dominated by northern white-cedar (*Thuja occidentalis*). **[CEGL002456] *Thuja occidentalis* - (*Picea mariana, Abies balsamea*) / *Alnus incana* Forest**

54B. Dominated by black spruce (*Picea mariana*). **[CEGL005271] *Picea mariana* - (*Larix laricina*) / *Ledum groenlandicum* / *Sphagnum* spp. Forest (black spruce phase)**

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 Apostle Islands National Lakeshore (APIS) 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 APIS. 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 Apostle Islands National Lakeshore.

Scientific Name	Common Name	Family
Acer	maple	Aceraceae
Acer negundo	boxelder	Aceraceae
Acer rubrum	red maple	Aceraceae
Acer saccharinum	silver maple	Aceraceae
Acer saccharum	sugar maple	Aceraceae
Acer spicatum	mountain maple	Aceraceae
Calliergon	calliergon moss	Amblystegiaceae
Campylium	campylium moss	Amblystegiaceae
Rhus hirta	staghorn sumac	Anacardiaceae
Toxicodendron radicans	eastern poison ivy	Anacardiaceae
Cicuta bulbifera	bulblet-bearing water hemlock	Apiaceae
Osmorhiza	sweetroot	Apiaceae
Osmorhiza berteroi	sweetcicely	Apiaceae
Osmorhiza claytonii	Clayton's sweetroot	Apiaceae
Apocynum androsaemifolium	spreading dogbane	Apocynaceae
Ilex verticillata	common winterberry	Aquifoliaceae
Nemopanthus mucronatus	catberry	Aquifoliaceae
Calla palustris	water arum	Araceae
Aralia nudicaulis	wild sarsaparilla	Araliaceae
Panax trifolius	dwarf ginseng	Araliaceae
Asclepias syriaca	common milkweed	Asclepiadaceae
Achillea millefolium	common yarrow	Asteraceae
Anaphalis margaritacea	western pearly everlasting	Asteraceae
Antennaria	pussytoes	Asteraceae
Artemisia campestris	field sagewort	Asteraceae
Artemisia campestris ssp. *caudata*	field sagewort	Asteraceae
Aster	aster	Asteraceae
Bidens	beggarticks	Asteraceae
Cirsium arvense	Canada thistle	Asteraceae
Cirsium vulgare	bull thistle	Asteraceae
Doellingeria umbellata var. *umbellata*	parasol whitetop	Asteraceae
Erigeron strigosus	prairie fleabane	Asteraceae
Eupatorium	thoroughwort	Asteraceae
Eupatorium maculatum	spotted joepyeweed	Asteraceae
Eupatorium perfoliatum	common boneset	Asteraceae

Scientific Name	Common Name	Family
Eurybia macrophylla	bigleaf aster	Asteraceae
Euthamia graminifolia	flat-top goldentop	Asteraceae
Hieracium	hawkweed	Asteraceae
Hieracium aurantiacum	orange hawkweed	Asteraceae
Hieracium caespitosum	meadow hawkweed	Asteraceae
Hieracium kalmii	Kalm's hawkweed	Asteraceae
Lactuca	lettuce	Asteraceae
Lactuca biennis	tall blue lettuce	Asteraceae
Packera paupercula	balsam groundsel	Asteraceae
Petasites frigidus	arctic sweet coltsfoot	Asteraceae
Pseudognaphalium obtusifolium ssp. *obtusifolium*	rabbittobacco	Asteraceae
Solidago	goldenrod	Asteraceae
Solidago canadensis	Canada goldenrod	Asteraceae
Solidago gigantea	giant goldenrod	Asteraceae
Solidago nemoralis	gray goldenrod	Asteraceae
Solidago uliginosa	bog goldenrod	Asteraceae
Sonchus arvensis ssp. *uliginosus*	moist sowthistle	Asteraceae
Symphyotrichum ciliolatum	Lindley's aster	Asteraceae
Symphyotrichum lanceolatum ssp. *lanceolatum* var. *lanceolatum*	white panicle aster	Asteraceae
Symphyotrichum lateriflorum	calico aster	Asteraceae
Symphyotrichum lateriflorum var. *lateriflorum*	calico aster	Asteraceae
Symphyotrichum puniceum var. *puniceum*	purplestem aster	Asteraceae
Tanacetum vulgare	common tansy	Asteraceae
Taraxacum officinale	common dandelion	Asteraceae
Impatiens	touch-me-not	Balsaminaceae
Impatiens capensis	jewelweed	Balsaminaceae
Alnus	alder	Betulaceae
Alnus incana	gray alder	Betulaceae
Alnus incana ssp. *rugosa*	speckled alder	Betulaceae
Alnus viridis	green alder	Betulaceae
Alnus viridis ssp. *crispa*	mountain alder	Betulaceae
Betula	birch	Betulaceae
Betula alleghaniensis	yellow birch	Betulaceae
Betula papyrifera	paper birch	Betulaceae
Betula pumila	bog birch	Betulaceae
Corylus cornuta	beaked hazelnut	Betulaceae
Ostrya virginiana	Chisos hophornbeam	Betulaceae
Brachythecium	brachythecium moss	Brachytheciaceae
Arabis lyrata	lyrate rockcress	Brassicaceae
Cardamine debilis	roadside bittercress	Brassicaceae
Brasenia schreberi	watershield	Cabombaceae
Campanula aparinoides	marsh bellflower	Campanulaceae
Campanula rotundifolia	bluebell bellflower	Campanulaceae
Lobelia kalmii	Ontario lobelia	Campanulaceae
Diervilla	bush honeysuckle	Caprifoliaceae
Diervilla lonicera	northern bush honeysuckle	Caprifoliaceae
Linnaea borealis	twinflower	Caprifoliaceae

Scientific Name	Common Name	Family
Lonicera	honeysuckle	Caprifoliaceae
Lonicera canadensis	American fly honeysuckle	Caprifoliaceae
Sambucus	elderberry	Caprifoliaceae
Sambucus nigra ssp. *canadensis*	common elderberry	Caprifoliaceae
Sambucus racemosa	red elderberry	Caprifoliaceae
Sambucus racemosa var. *racemosa*	red elderberry	Caprifoliaceae
Symphoricarpos albus	common snowberry	Caprifoliaceae
Viburnum edule	squashberry	Caprifoliaceae
Viburnum nudum	possumhaw	Caprifoliaceae
Viburnum opulus var. *americanum*	American cranberrybush	Caprifoliaceae
Cerastium	mouse-ear chickweed	Caryophyllaceae
Stellaria	starwort	Caryophyllaceae
Ceratophyllum demersum	coon's tail	Ceratophyllaceae
Hudsonia tomentosa	woolly beachheather	Cistaceae
Cladina	reindeer lichen	Cladoniaceae
Cladina stellaris var. *aberrans*	star reindeer lichen	Cladoniaceae
Cladonia	cup lichen	Cladoniaceae
Cladonia cristatella	cup lichen	Cladoniaceae
Hypericum	St. Johnswort	Clusiaceae
Hypericum canadense	lesser Canadian St. Johnswort	Clusiaceae
Triadenum fraseri	Fraser's marsh St. Johnswort	Clusiaceae
Triadenum virginicum	Virginia marsh St. Johnswort	Clusiaceae
Cornus	dogwood	Cornaceae
Cornus canadensis	bunchberry dogwood	Cornaceae
Cornus sericea	redosier dogwood	Cornaceae
Cornus sericea ssp. *sericea*	redosier dogwood	Cornaceae
Juniperus communis	common juniper	Cupressaceae
Thuja occidentalis	arborvitae	Cupressaceae
Carex	sedge	Cyperaceae
Carex aquatilis	water sedge	Cyperaceae
Carex arcta	northern cluster sedge	Cyperaceae
Carex arctata	drooping woodland sedge	Cyperaceae
Carex brunnescens	brownish sedge	Cyperaceae
Carex canescens	silvery sedge	Cyperaceae
Carex chordorrhiza	creeping sedge	Cyperaceae
Carex communis	fibrousroot sedge	Cyperaceae
Carex comosa	longhair sedge	Cyperaceae
Carex crinita	fringed sedge	Cyperaceae
Carex deweyana	Dewey sedge	Cyperaceae
Carex disperma	softleaf sedge	Cyperaceae
Carex echinata ssp. *echinata*	star sedge	Cyperaceae
Carex exilis	coastal sedge	Cyperaceae
Carex gracillima	graceful sedge	Cyperaceae
Carex gynandra	nodding sedge	Cyperaceae
Carex intumescens	greater bladder sedge	Cyperaceae
Carex lacustris	hairy sedge	Cyperaceae
Carex lasiocarpa	woollyfruit sedge	Cyperaceae
Carex lenticularis	lakeshore sedge	Cyperaceae

Scientific Name	Common Name	Family
Carex leptalea	bristlystalked sedge	Cyperaceae
Carex leptonervia	nerveless woodland sedge	Cyperaceae
Carex limosa	mud sedge	Cyperaceae
Carex livida	livid sedge	Cyperaceae
Carex magellanica ssp. *irrigua*	boreal bog sedge	Cyperaceae
Carex michauxiana	Michaux's sedge	Cyperaceae
Carex oligocarpa	richwoods sedge	Cyperaceae
Carex oligosperma	fewseed sedge	Cyperaceae
Carex ovalis	eggbract sedge	Cyperaceae
Carex pedunculata	longstalk sedge	Cyperaceae
Carex pensylvanica	Pennsylvania sedge	Cyperaceae
Carex retrorsa	knotsheath sedge	Cyperaceae
Carex rostrata	beaked sedge	Cyperaceae
Carex scabrata	eastern rough sedge	Cyperaceae
Carex scoparia	broom sedge	Cyperaceae
Carex stipata	owlfruit sedge	Cyperaceae
Carex stricta	upright sedge	Cyperaceae
Carex tonsa var. *rugosperma*	parachute sedge	Cyperaceae
Carex trisperma	threeseeded sedge	Cyperaceae
Carex utriculata	Northwest Territory sedge	Cyperaceae
Carex vesicaria	blister sedge	Cyperaceae
Carex viridula	little green sedge	Cyperaceae
Carex vulpinoidea	fox sedge	Cyperaceae
Cladium mariscoides	smooth sawgrass	Cyperaceae
Dulichium arundinaceum	threeway sedge	Cyperaceae
Eleocharis	spikerush	Cyperaceae
Eleocharis obtusa	blunt spikerush	Cyperaceae
Eleocharis robbinsii	Robbins' spikerush	Cyperaceae
Eriophorum	cottongrass	Cyperaceae
Eriophorum vaginatum var. *spissum*	tussock cottongrass	Cyperaceae
Eriophorum virginicum	tawny cottongrass	Cyperaceae
Rhynchospora	beaksedge	Cyperaceae
Rhynchospora alba	white beaksedge	Cyperaceae
Rhynchospora fusca	brown beaksedge	Cyperaceae
Schoenoplectus acutus var. *acutus*	hardstem bulrush	Cyperaceae
Schoenoplectus subterminalis	swaying bulrush	Cyperaceae
Scirpus	bulrush	Cyperaceae
Scirpus atrovirens	green bulrush	Cyperaceae
Scirpus cyperinus	woolgrass	Cyperaceae
Pteridium aquilinum	western brackenfern	Dennstaedtiaceae
Dicranum	dicranum moss	Dicranaceae
Dicranum scoparium	dicranum moss	Dicranaceae
Drosera intermedia	spoonleaf sundew	Droseraceae
Drosera rotundifolia	roundleaf sundew	Droseraceae
Athyrium filix-femina	common ladyfern	Dryopteridaceae
Athyrium filix-femina ssp. *angustum*	subarctic ladyfern	Dryopteridaceae
Cystopteris fragilis	brittle bladderfern	Dryopteridaceae
Dryopteris	woodfern	Dryopteridaceae

Scientific Name	Common Name	Family
Dryopteris carthusiana	spinulose woodfern	Dryopteridaceae
Dryopteris cristata	crested woodfern	Dryopteridaceae
Dryopteris intermedia	intermediate woodfern	Dryopteridaceae
Gymnocarpium	oakfern	Dryopteridaceae
Gymnocarpium dryopteris	western oakfern	Dryopteridaceae
Gymnocarpium robertianum	scented oakfern	Dryopteridaceae
Matteuccia struthiopteris	ostrich fern	Dryopteridaceae
Onoclea sensibilis	sensitive fern	Dryopteridaceae
Equisetum	horsetail	Equisetaceae
Equisetum arvense	field horsetail	Equisetaceae
Equisetum fluviatile	water horsetail	Equisetaceae
Equisetum hyemale	scouringrush horsetail	Equisetaceae
Equisetum palustre	marsh horsetail	Equisetaceae
Equisetum scirpoides	dwarf scouringrush	Equisetaceae
Equisetum sylvaticum	woodland horsetail	Equisetaceae
Andromeda polifolia	bog rosemary	Ericaceae
Andromeda polifolia var. *glaucophylla*	bog rosemary	Ericaceae
Arbutus	madrone	Ericaceae
Arctostaphylos uva-ursi	kinnikinnick	Ericaceae
Chamaedaphne calyculata	leatherleaf	Ericaceae
Epigaea repens	trailing arbutus	Ericaceae
Gaultheria hispidula	creeping snowberry	Ericaceae
Gaultheria procumbens	eastern teaberry	Ericaceae
Gaylussacia	huckleberry	Ericaceae
Gaylussacia baccata	black huckleberry	Ericaceae
Kalmia	laurel	Ericaceae
Kalmia polifolia	bog laurel	Ericaceae
Ledum groenlandicum	bog Labrador tea	Ericaceae
Vaccinium angustifolium	lowbush blueberry	Ericaceae
Vaccinium macrocarpon	cranberry	Ericaceae
Vaccinium myrtilloides	velvetleaf huckleberry	Ericaceae
Vaccinium oxycoccos	small cranberry	Ericaceae
Eriocaulon aquaticum	sevenangle pipewort	Eriocaulaceae
Lathyrus	pea	Fabaceae
Lathyrus japonicus	beach pea	Fabaceae
Trifolium pratense	red clover	Fabaceae
Trifolium repens	white clover	Fabaceae
Quercus	oak	Fagaceae
Quercus ellipsoidalis	northern pin oak	Fagaceae
Quercus rubra	northern red oak	Fagaceae
Quercus rubra var. *ambigua*	northern red oak	Fagaceae
Gentiana andrewsii	closed bottle gentian	Gentianaceae
Grimmia	grimmia dry rock moss	Grimmiaceae
Ribes	currant	Grossulariaceae
Ribes glandulosum	skunk currant	Grossulariaceae
Ribes triste	red currant	Grossulariaceae
Vallisneria	eelgrass	Hydrocharitaceae
Hylocomium splendens	splendid feather moss	Hylocomiaceae

Scientific Name	Common Name	Family
Pleurozium schreberi	Schreber's big red stem moss	Hylocomiaceae
Ptilium crista-castrensis	knights plume moss	Hypnaceae
Iris verna	dwarf violet iris	Iridaceae
Iris versicolor	harlequin blueflag	Iridaceae
Juncus	rush	Juncaceae
Juncus balticus	Baltic rush	Juncaceae
Juncus canadensis	Canadian rush	Juncaceae
Juncus effusus	common rush	Juncaceae
Galeopsis tetrahit	brittlestem hempnettle	Lamiaceae
Lamium	deadnettle	Lamiaceae
Lycopus americanus	American water horehound	Lamiaceae
Lycopus uniflorus	northern bugleweed	Lamiaceae
Lycopus virginicus	Virginia water horehound	Lamiaceae
Prunella vulgaris	common selfheal	Lamiaceae
Scutellaria galericulata	marsh skullcap	Lamiaceae
Scutellaria lateriflora	blue skullcap	Lamiaceae
Lemna minor	common duckweed	Lemnaceae
Utricularia	bladderwort	Lentibulariaceae
Utricularia cornuta	horned bladderwort	Lentibulariaceae
Utricularia intermedia	flatleaf bladderwort	Lentibulariaceae
Utricularia macrorhiza	common bladderwort	Lentibulariaceae
Utricularia minor	lesser bladderwort	Lentibulariaceae
Bazzania trilobata		Lepidoziaceae
Leucobryum glaucum	leucobryum moss	Leucobryaceae
Clintonia borealis	bluebead	Liliaceae
Maianthemum	mayflower	Liliaceae
Maianthemum canadense	Canada mayflower	Liliaceae
Maianthemum racemosum	feathery false lily of the vally	Liliaceae
Maianthemum racemosum ssp. *racemosum*	feathery false lily of the vally	Liliaceae
Maianthemum trifolium	threeleaf false lily of the vally	Liliaceae
Polygonatum biflorum	smooth Solomon's seal	Liliaceae
Polygonatum pubescens	hairy Solomon's seal	Liliaceae
Streptopus amplexifolius	claspleaf twistedstalk	Liliaceae
Streptopus lanceolatus	twistedstalk	Liliaceae
Streptopus lanceolatus var. *roseus*	twistedstalk	Liliaceae
Trillium	trillium	Liliaceae
Trillium cernuum	whip-poor-will flower	Liliaceae
Uvularia	bellwort	Liliaceae
Uvularia perfoliata	perfoliate bellwort	Liliaceae
Uvularia sessilifolia	sessileleaf bellwort	Liliaceae
Lobaria pulmonaria	lung lichen	Lobariaceae
Huperzia lucidula	shining clubmoss	Lycopodiaceae
Lycopodiella inundata	inundated clubmoss	Lycopodiaceae
Lycopodium	clubmoss	Lycopodiaceae
Lycopodium annotinum	stiff clubmoss	Lycopodiaceae
Lycopodium clavatum	running clubmoss	Lycopodiaceae
Lycopodium dendroideum	tree groundpine	Lycopodiaceae
Lycopodium digitatum	fan clubmoss	Lycopodiaceae

Scientific Name	Common Name	Family
Lycopodium obscurum	rare clubmoss	Lycopodiaceae
Lythrum salicaria	purple loosestrife	Lythraceae
Abutilon abutiloides	shrubby Indian mallow	Malvaceae
Menyanthes trifoliata	buckbean	Menyanthaceae
Mnium	mnium calcareous moss	Mniaceae
Monotropa hypopithys	pinesap	Monotropaceae
Monotropa uniflora	Indianpipe	Monotropaceae
Myrica gale	sweetgale	Myricaceae
Nuphar lutea	yellow pond-lily	Nymphaeaceae
Nuphar lutea ssp. *variegata*	varigated yellow pond-lily	Nymphaeaceae
Nymphaea odorata ssp. *tuberosa*	American white waterlily	Nymphaeaceae
Fraxinus	ash	Oleaceae
Fraxinus nigra	black ash	Oleaceae
Fraxinus pennsylvanica	green ash	Oleaceae
Chamerion angustifolium	fireweed	Onagraceae
Chamerion angustifolium ssp. *angustifolium*	fireweed	Onagraceae
Circaea	enchanter's nightshade	Onagraceae
Epilobium	willowherb	Onagraceae
Epilobium ciliatum	fringed willowherb	Onagraceae
Epilobium leptophyllum	bog willowherb	Onagraceae
Oenothera	evening-primrose	Onagraceae
Oenothera biennis	common evening-primrose	Onagraceae
Oenothera oakesiana	Oakes' evening-primrose	Onagraceae
Botrychium multifidum	leathery grapefern	Ophioglossaceae
Calopogon tuberosus	tuberous grasspink	Orchidaceae
Corallorrhiza	coralroot	Orchidaceae
Corallorrhiza maculata	summer coralroot	Orchidaceae
Corallorrhiza striata	hooded coralroot	Orchidaceae
Cypripedium acaule	moccasin flower	Orchidaceae
Goodyera	rattlesnake plantain	Orchidaceae
Goodyera oblongifolia	western rattlesnake plantain	Orchidaceae
Goodyera repens	lesser rattlesnake plantain	Orchidaceae
Malaxis unifolia	green adder's-mouth orchid	Orchidaceae
Platanthera clavellata	small green wood orchid	Orchidaceae
Platanthera hyperborea	northern green orchid	Orchidaceae
Pogonia ophioglossoides	snakemouth orchid	Orchidaceae
Spiranthes	ladies'-tresses	Orchidaceae
Epifagus	beechdrops	Orobanchaceae
Osmunda	osmunda	Osmundaceae
Osmunda cinnamomea	cinnamon fern	Osmundaceae
Osmunda claytoniana	interrupted fern	Osmundaceae
Osmunda regalis	royal fern	Osmundaceae
Oxalis	woodsorrel	Oxalidaceae
Oxalis montana	mountain woodsorrel	Oxalidaceae
Usnea	beard lichen	Parmeliaceae
Peltigera	felt lichen	Peltigeraceae
Abies	fir	Pinaceae
Abies balsamea	balsam fir	Pinaceae

Scientific Name	Common Name	Family
Larix laricina	tamarack	Pinaceae
Picea glauca	white spruce	Pinaceae
Picea mariana	black spruce	Pinaceae
Pinus banksiana	jack pine	Pinaceae
Pinus resinosa	red pine	Pinaceae
Pinus strobus	eastern white pine	Pinaceae
Tsuga canadensis	eastern hemlock	Pinaceae
Agropyron	wheatgrass	Poaceae
Agrostis	bentgrass	Poaceae
Agrostis gigantea	redtop	Poaceae
Agrostis hyemalis	winter bentgrass	Poaceae
Agrostis scabra	rough bentgrass	Poaceae
Ammophila breviligulata	American beachgrass	Poaceae
Brachyelytrum erectum	bearded shorthusk	Poaceae
Bromus ciliatus	fringed brome	Poaceae
Bromus inermis	smooth brome	Poaceae
Calamagrostis canadensis	bluejoint	Poaceae
Calamagrostis stricta ssp. *inexpansa*	northern reedgrass	Poaceae
Cinna	woodreed	Poaceae
Cinna latifolia	drooping woodreed	Poaceae
Danthonia spicata	poverty oatgrass	Poaceae
Deschampsia	hairgrass	Poaceae
Deschampsia flexuosa	wavy hairgrass	Poaceae
Deschampsia flexuosa var. flexuosa	wavy hairgrass	Poaceae
Dichanthelium acuminatum var. *fasciculatum*	western panicgrass	Poaceae
Elymus	wildrye	Poaceae
Elymus canadensis	Canada wildrye	Poaceae
Elymus hystrix	eastern bottlebrush grass	Poaceae
Elymus repens	quackgrass	Poaceae
Elymus trachycaulus	slender wheatgrass	Poaceae
Festuca	fescue	Poaceae
Festuca saximontana	Rocky Mountain fescue	Poaceae
Glyceria	mannagrass	Poaceae
Glyceria canadensis	rattlesnake mannagrass	Poaceae
Glyceria grandis	American mannagrass	Poaceae
Glyceria striata	fowl mannagrass	Poaceae
Leersia oryzoides	rice cutgrass	Poaceae
Melica	melicgrass	Poaceae
Milium effusum	American milletgrass	Poaceae
Oryzopsis asperifolia	roughleaf ricegrass	Poaceae
Panicum	panicgrass	Poaceae
Phalaris arundinacea	reed canarygrass	Poaceae
Phleum	timothy	Poaceae
Phleum pratense	timothy	Poaceae
Phragmites australis	common reed	Poaceae
Poa	bluegrass	Poaceae
Poa annua	annual bluegrass	Poaceae
Poa compressa	Canada bluegrass	Poaceae

Scientific Name	Common Name	Family
Poa palustris	fowl bluegrass	Poaceae
Poa pratensis	Kentucky bluegrass	Poaceae
Poa sylvestris	woodland bluegrass	Poaceae
Schizachyrium scoparium	little bluestem	Poaceae
Torreyochloa pallida	pale false mannagrass	Poaceae
Polygala paucifolia	gaywings	Polygalaceae
Polygonella articulata	coastal jointweed	Polygonaceae
Polygonum	knotweed	Polygonaceae
Polygonum amphibium	water knotweed	Polygonaceae
Polygonum cilinode	fringed black bindweed	Polygonaceae
Polygonum hydropiper	marshpepper knotweed	Polygonaceae
Rumex	dock	Polygonaceae
Rumex acetosella	common sheep sorrel	Polygonaceae
Rumex orbiculatus	greater water dock	Polygonaceae
Polypodium virginianum	rock polypody	Polypodiaceae
Polytrichum	polytrichum moss	Polytrichaceae
Polytrichum commune	polytrichum moss	Polytrichaceae
Polytrichum juniperinum	juniper polytrichum moss	Polytrichaceae
Heteranthera dubia	grassleaf mudplantain	Pontederiaceae
Potamogeton	pondweed	Potamogetonaceae
Potamogeton amplifolius	largeleaf pondweed	Potamogetonaceae
Potamogeton pusillus ssp. *tenuissimus*	small pondweed	Potamogetonaceae
Lysimachia	yellow loosestrife	Primulaceae
Lysimachia terrestris	earth loosestrife	Primulaceae
Lysimachia thyrsiflora	tufted loosestrife	Primulaceae
Primula mistassinica	Mistassini primrose	Primulaceae
Trientalis borealis	starflower	Primulaceae
Ptilidium		Ptilidiaceae
Chimaphila umbellata	pipsissewa	Pyrolaceae
Moneses uniflora	single delight	Pyrolaceae
Orthilia secunda	sidebells wintergreen	Pyrolaceae
Pyrola	wintergreen	Pyrolaceae
Pyrola asarifolia	liverleaf wintergreen	Pyrolaceae
Pyrola elliptica	waxflower shinleaf	Pyrolaceae
Actaea	baneberry	Ranunculaceae
Actaea pachypoda	white baneberry	Ranunculaceae
Actaea rubra	red baneberry	Ranunculaceae
Anemone quinquefolia	nightcaps	Ranunculaceae
Caltha palustris	yellow marsh marigold	Ranunculaceae
Clematis virginiana	devil's darning needles	Ranunculaceae
Coptis trifolia	threeleaf goldthread	Ranunculaceae
Ranunculus	buttercup	Ranunculaceae
Ranunculus acris	tall buttercup	Ranunculaceae
Thalictrum dasycarpum	purple meadow-rue	Ranunculaceae
Thalictrum dioicum	early meadow-rue	Ranunculaceae
Thalictrum thalictroides	rue anemone	Ranunculaceae
Amelanchier	serviceberry	Rosaceae
Amelanchier laevis	Allegheny serviceberry	Rosaceae

Scientific Name	Common Name	Family
Comarum palustre	purple marshlocks	Rosaceae
Fragaria	strawberry	Rosaceae
Fragaria virginiana	Virginia strawberry	Rosaceae
Geum	avens	Rosaceae
Geum aleppicum	yellow avens	Rosaceae
Physocarpus opulifolius	common ninebark	Rosaceae
Potentilla norvegica	Norwegian cinquefoil	Rosaceae
Prunus pensylvanica	pin cherry	Rosaceae
Prunus pumila	sandcherry	Rosaceae
Prunus virginiana	chokecherry	Rosaceae
Rosa	rose	Rosaceae
Rosa acicularis	prickly rose	Rosaceae
Rosa blanda	smooth rose	Rosaceae
Rubus	blackberry	Rosaceae
Rubus allegheniensis	Allegheny blackberry	Rosaceae
Rubus hispidus	bristly dewberry	Rosaceae
Rubus idaeus	American red raspberry	Rosaceae
Rubus idaeus ssp. *strigosus*	grayleaf red raspberry	Rosaceae
Rubus occidentalis	black raspberry	Rosaceae
Rubus parviflorus	thimbleberry	Rosaceae
Rubus pubescens	dwarf red blackberry	Rosaceae
Sibbaldiopsis tridentata	shrubby fivefingers	Rosaceae
Sorbus	mountain ash	Rosaceae
Sorbus americana	American mountain ash	Rosaceae
Sorbus aucuparia	European mountain ash	Rosaceae
Sorbus decora	northern mountain ash	Rosaceae
Spiraea alba	white meadowsweet	Rosaceae
Galium	bedstraw	Rubiaceae
Galium asprellum	rough bedstraw	Rubiaceae
Galium circaezans var. *circaezans*	licorice bedstraw	Rubiaceae
Galium labradoricum	northern bog bedstraw	Rubiaceae
Galium tinctorium	stiff marsh bedstraw	Rubiaceae
Galium trifidum	threepetal bedstraw	Rubiaceae
Galium triflorum	fragrant bedstraw	Rubiaceae
Mitchella repens	partridgeberry	Rubiaceae
Populus	cottonwood	Salicaceae
Populus balsamifera	balsam poplar	Salicaceae
Populus grandidentata	bigtooth aspen	Salicaceae
Populus tremuloides	quaking aspen	Salicaceae
Salix	willow	Salicaceae
Salix bebbiana	Bebb willow	Salicaceae
Salix discolor	pussy willow	Salicaceae
Salix eriocephala	Missouri River willow	Salicaceae
Salix exigua	narrowleaf willow	Salicaceae
Salix lucida	shining willow	Salicaceae
Salix pedicellaris	bog willow	Salicaceae
Salix pentandra	laurel willow	Salicaceae
Salix petiolaris	meadow willow	Salicaceae

Scientific Name	Common Name	Family
Salix pyrifolia	balsam willow	Salicaceae
Salix serissima	autumn willow	Salicaceae
Comandra umbellata	bastard toadflax	Santalaceae
Sarracenia	pitcherplant	Sarraceniaceae
Sarracenia purpurea	purple pitcherplant	Sarraceniaceae
Sarracenia purpurea ssp. *purpurea*	purple pitcherplant	Sarraceniaceae
Scheuchzeria palustris	rannoch-rush	Scheuchzeriaceae
Chelone glabra	white turtlehead	Scrophulariaceae
Melampyrum lineare	narrowleaf cowwheat	Scrophulariaceae
Mimulus ringens	Allegheny monkeyflower	Scrophulariaceae
Verbascum thapsus	common mullein	Scrophulariaceae
Sparganium	bur-reed	Sparganiaceae
Sparganium erectum ssp. *stoloniferum*	simplestem bur-reed	Sparganiaceae
Sparganium eurycarpum	broadfruit bur-reed	Sparganiaceae
Sparganium fluctuans	floating bur-reed	Sparganiaceae
Sphagnum	sphagnum	Sphagnaceae
Sphagnum capillifolium	sphagnum	Sphagnaceae
Sphagnum centrale	sphagnum	Sphagnaceae
Sphagnum compactum	low sphagnum	Sphagnaceae
Sphagnum contortum	contorted sphagnum	Sphagnaceae
Sphagnum fallax	sphagnum	Sphagnaceae
Sphagnum fuscum	sphagnum	Sphagnaceae
Sphagnum girgensohnii	Girgensohn's sphagnum	Sphagnaceae
Sphagnum magellanicum	Magellan's sphagnum	Sphagnaceae
Sphagnum papillosum	papillose sphagnum	Sphagnaceae
Sphagnum rubellum	sphagnum	Sphagnaceae
Sphagnum squarrosum	sphagnum	Sphagnaceae
Sphagnum wulfianum	Wulf's sphagnum	Sphagnaceae
Taxus canadensis	Canada yew	Taxaceae
Phegopteris	beechfern	Thelypteridaceae
Phegopteris connectilis	long beechfern	Thelypteridaceae
Phegopteris hexagonoptera	broad beechfern	Thelypteridaceae
Thelypteris palustris	eastern marsh fern	Thelypteridaceae
Tilia americana	American basswood	Tiliaceae
Typha	cattail	Typhaceae
Typha angustifolia	narrowleaf cattail	Typhaceae
Typha latifolia	broadleaf cattail	Typhaceae
Laportea canadensis	Canadian woodnettle	Urticaceae
Urtica dioica	stinging nettle	Urticaceae
Viola	violet	Violaceae
Viola macloskeyi	small white violet	Violaceae
Viola sororia	common blue violet	Violaceae

Appendix E: Descriptions of Map Classes

Explanation of Map-class Descriptions

This appendix to the Main Report of the Apostle Islands National Lakeshore (APIS) vegetation mapping project provides descriptions to the 63 map classes we used to map the APIS and environs for the National Park Service (NPS) Vegetation Inventory Program (VIP). Of these 63 map classes, 59 represent vegetation types within the National Vegetation Classification Standard (NVCS) (FGDC 2008), where another four represent non-vegetated units (open water, barren land). 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[1]. (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 the APIS and immediate environs 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 the APIS and immediate environs. 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., sugar maple, 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 hierarchy within the NVCS (FGDC 2008). We organized map classes representing non-vegetated features (e.g., open water) with the classification in the NLCD. Map classification codes, names, and their crosswalk to the NVCS and the 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.

[1]One map class, Alder - Willow Shore Fen (SAW), was renamed differently than the association’s synonym name. The true synonym name is Bog Birch - Willow Shore Fen.

Minimum Mapping Units

Map classes were generally mapped to the NPS VIP minimum mapping unit (MMU) standard of 0.5 ha (1.24 acres). For types unique to its immediate surroundings (e.g., herbaceous wetland within an upland forest setting), we allowed for mapping below the MMU down to 0.25 ha (0.62 acres); however, we purposely set an MMU of 0.25 ha (0.62 acres) for the mapping of two sparse vegetation map classes–Great Lakes Sandstone Bedrock Shore (VBS) and Great Lakes Shore Sandstone Cliff (VSC). In addition, we applied a secondary MMU of 2.0 ha (4.94 acres) 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.

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Table E-1. Map classification with crosswalk to the National Vegetation Classification Standard (Version 2) for the Apostle Islands National Lakeshore vegetation mapping project.

[NVCS, National Vegetation Classification Standard; NLCD, National Land Cover Database; MMU, minimum mapping unit]

Map-class Code	Map-class Name
1. FOREST & WOODLAND CLASS	
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	
Acer saccharum - *Betula alleghaniensis* - (*Tilia americana*) Forest Association (CEGL002457)	
FMB	Maple - Yellow Birch Northern Hardwoods Forest
Acer saccharum - *Tilia americana* / *Ostrya virginiana* / *Lonicera canadensis* Forest Association (CEGL002458)	
FMT	Northern Maple - Basswood Forest
Betula alleghaniensis - (*Acer saccharum*, *Picea glauca*) Forest [Provisional] Association (CEGL005245)	
FYB	Yellow Birch - (White Spruce) Forest
Pinus strobus - *Tsuga canadensis* Great Lakes Forest Association (CEGL002590)	
FWH	Great Lakes White Pine - Hemlock Forest
Populus tremuloides - *Betula papyrifera* - (*Acer rubrum*, *Populus grandidentata*) Forest Association (CEGL002467)	
FBR	Aspen - Birch - Red Maple Forest
Populus tremuloides - *Betula papyrifera* / *Acer saccharum* - Mixed Hardwoods Forest Association (CEGL002468)	
FAM	Aspen - Birch / Sugar Maple - Mixed Hardwoods Forest
Quercus rubra - *Acer saccharum* - (*Betula alleghaniensis*)Forest Association (CEGL002461)	
FOM	Northern Red Oak - Sugar Maple Forest
Thuja occidentalis / *Abies balsamea* - *Acer spicatum* Forest Association (CEGL002449)	
FCC	White-cedar - Boreal Conifer Mesic Forest (conifer phase)
FCM	White-cedar - Boreal Conifer Mesic Forest (conifer - hardwood phase)
Tsuga canadensis - (*Betula alleghaniensis*) Forest Association (CEGL002598)	
FHC	Hemlock Mesic Forest
Tsuga canadensis - *Acer saccharum* - *Betula alleghaniensis* Forest Association (CEGL005044)	
FHM	North-Central Hemlock - Hardwood Forest

Map-class Code	Map-class Name
	G025. White Pine - Red Pine - Jack Pine - Oak Forest & Woodland Group
	Pinus banksiana - (*Pinus resinosa*) - *Quercus ellipsoidalis* / *Carex pensylvanica* Forest Association (CEGL002478)
FJO	Jack Pine - Northern Pin Oak Forest
	Pinus resinosa - *Populus tremuloides* / *Diervilla lonicera* - *Vaccinium* spp. Forest Association (CEGL002520)
FRA	Red Pine - Aspen - Birch Forest
	Pinus resinosa / *Vaccinium* spp. Forest Association (CEGL002443)
FRP	Red Pine / Blueberry Dry Forest
	Pinus strobus - *Populus tremuloides* / *Corylus cornuta* Forest Association (CEGL002479)
FWA	White Pine - Aspen - Birch Forest
	Pinus strobus / *Acer spicatum* - *Corylus cornuta* Forest Association (CEGL002445)
FWM	White Pine / Mountain Maple Mesic Forest
	Pinus strobus / *Vaccinium* spp. Forest Association (CEGL002444)
FWP	White Pine / Blueberry Dry-Mesic Forest
	Quercus ellipsoidalis - *(Quercus macrocarpa)* Forest Association (CEGL002077)
FPO	Northern Pin Oak - (Bur Oak) Forest
	MG159. Northern Pine - Oak Woodland & Barrens Macrogroup
	G160. Great Lakes Pine Barrens Group
	Pinus banksiana - *Pinus resinosa* - *Pinus strobus* Dune Forest Association (CEGL002589)
FPD	Great Lakes Dune Pine Forest
	MG013. Eastern North American Ruderal Forest & Plantation Macrogroup
	G030. Northern & Central Hardwood & Conifer Ruderal Forest Group
FDX	Hardwood Ruderal Forest
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
	Acer rubrum - *Fraxinus* spp. - *Betula papyrifera* / *Cornus canadensis* Forest Association (CEGL002071)
FRM	Red Maple - Ash - Birch Swamp Forest

Map-class Code	Map-class Name
	Fraxinus nigra - Mixed Hardwoods - Conifers / *Cornus sericea* / *Carex* spp. Forest Association (CEGL002105)
FBA	Black Ash - Mixed Hardwood Swamp
	Thuja occidentalis - *Fraxinus nigra* Forest Association (CEGL005165)
FCA	White-cedar - Black Ash Swamp
	Tsuga canadensis - *Betula alleghaniensis* Saturated Forest Association (CEGL005003)
FHS	Hemlock - Yellow Birch Swamp Wet-Mesic Forest
MG160. Northern & Central Tall Shrub Wetland Macrogroup	
G167. Northern & Central Shrub Swamp Group	
	Alnus incana Swamp Shrubland Association (CEGL002381)
SAS	Gray Alder Swamp Shrubland
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	
	Picea mariana / *Pleurozium schreberi* Forest Association (CEGL002447)
FBS	Black Spruce / Feathermoss Forest
	Pinus banksiana - *Populus tremuloides* / *Diervilla lonicera* Forest Association (CEGL002518)
FJM	Jack Pine - Aspen / Bush-honeysuckle Forest
	Pinus banksiana / *Vaccinium* spp. / *Pleurozium schreberi* Forest Association (CEGL002441)
FJB	Jack Pine / Blueberry / Feathermoss Forest
G048. White Spruce - Balsam Fir Forest Group	
	Abies balsamea - *Betula papyrifera* / *Diervilla lonicera* Forest Association (CEGL002474)
FBF	Balsam Fir - Paper Birch Forest (conifer phase)
FFB	Balsam Fir - Paper Birch Forest (conifer - hardwood phase)
	Betula papyrifera / *Diervilla lonicera* - (*Abies balsamea*) Forest Association (CEGL002463)
FPB	Paper Birch / Fir Forest
	Populus tremuloides - *Betula papyrifera* / (*Abies balsamea*, *Picea glauca*) Forest Association (CEGL002466)
FAC	Aspen - Birch / Boreal Conifer Forest

Map-class Code	Map-class Name
	1.D.2.a. North American Boreal Flooded & Swamp Forest Division
	MG038. Central & Eastern Boreal Flooded & Swamp Forest Macrogroup
	G050. Black Spruce - Tamarack Acidic Swamp Group
	Picea mariana - (*Larix laricina*) / *Ledum groenlandicum* / *Sphagnum* spp. Forest Association (CEGL005271)
FSS	Black Spruce - Tamarack / Labrador-tea Poor Swamp (black spruce phase)
FTP	Black Spruce - Tamarack / Labrador-tea Poor Swamp (tamarack phase)
	G051. Tamarack - Conifer Alkaline Swamp Group
	Larix laricina / *Alnus incana* Forest Association (CEGL002471)
FTR	Northern Tamarack Rich Swamp
	Thuja occidentalis - (*Picea mariana*, *Abies balsamea*) / *Alnus incana* Forest Association (CEGL002456)
FCS	White-cedar - (Mixed Conifer) / Alder Swamp
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
SMX	Conifer - Deciduous Ruderal Shrubland
HMX	Ruderal Grassland
	2.C.3.a. Eastern North American Coastal Grassland & Shrubland Division
	MG057. Eastern North American Coastal Grassland & Shrubland Macrogroup
	G089. Great Lakes Coast Grassland & Shrubland Group
	Ammophila breviligulata - (*Schizachyrium scoparium*) Herbaceous Vegetation Association (CEGL005098)
HAB	Great Lakes Beachgrass Dune
	Hudsonia tomentosa Dune Dwarf-shrubland Association (CEGL004024)
DBH	Great Lakes Beach-heather Dune Dwarf-shrubland
	Juniperus horizontalis - *Arctostaphylos uva-ursi* - *Juniperus communis* Dune Dwarf-shrubland Association (CEGL005064)
DJD	Great Lakes Juniper Dune Shrubland
	Pinus banksiana - (*Pinus resinosa*) - *Pinus strobus* / *Juniperus horizontalis* Wooded Herbaceous Vegetation Association (CEGL005125)
HPB	Great Lakes Coast Pine Barrens (barrens phase)
HPW	Great Lakes Coast Pine Barrens (woodland phase)

Map-class Code	Map-class Name
	2.C.4.a. North American Bog & Fen Division
	MG062. North American Boreal Bog & Fen Macrogroup
	G185. Boreal Alkaline Peatland Group
	Alnus incana - *Salix* spp. - *Betula pumila* / *Chamaedaphne calyculata* Shrubland Association (CEGL005227)
SAW	Alder - Willow Shore Fen
	Carex lasiocarpa - (*Carex rostrata*) - *Equisetum fluviatile* Herbaceous Vegetation Association (CEGL005229)
HSS	Wiregrass Sedge Shore Fen
	G053. North American Boreal Acidic Peatland Group
	Chamaedaphne calyculata - *Myrica gale* / *Carex lasiocarpa* Dwarf-shrubland Association (CEGL005228)
DLS	Leatherleaf - Sweetgale Shore Fen
	Chamaedaphne calyculata / *Carex oligosperma* / *Sphagnum* spp. Poor Fen Dwarf-shrubland Association (CEGL005277)
DLF	Leatherleaf Poor Fen
	2.C.5.a. Eastern North America Freshwater Wet Meadow, Riparian & Marsh Division
	MG069. Eastern & North-Central North American Marsh & Wet Meadow Macrogroup
	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
	G189. Herbaceous Forested Seep Group
	Clay Seeps Sparse Vegetation Association (CEGL005163)
N/A	Clay Seeps
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 & Rock Vegetation Division	
MG111. Eastern North American Cliff & Rock Vegetation Macrogroup	
G340. Eastern North American Lake & River Bluff Group [Placeholder]	
Eroding Clay Bank Sparse Vegetation Association (CEGL002584)	
VEB	Eroding Clay Bank
G341. Great Lakes Cliff & Shore Group [Placeholder]	
Sandstone Bedrock Great Lakes Shore Sparse Vegetation Association (CEGL002507)	
VBS*	Great Lakes Sandstone Bedrock Shore
Sandstone Great Lakes Shore Cliff Sparse Vegetation Association (CEGL002503)	
VSC*	Great Lakes Shore Sandstone Cliff
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 (<1% vegetated)	
Non-Vegetated Water	
Open Water (NLCD 2001; 11)	
NSR	Stream & River
NWP	Open Water Pond
NWL	Open Water Lake
Non-Vegetated Land	
Barren Land (NLCD 2001; 31)	
NSB	Sand & Cobble Beach

*Mapped to a non-standard MMU of 0.25 ha.

Maple - Yellow Birch Northern Hardwoods Forest (FMB)

The Maple - Yellow Birch Northern Hardwoods Forest (FMB) map class represents the *Acer saccharum - Betula alleghaniensis* - (*Tilia americana*) Forest Association (CEGL002457) in the NVCS. This map class captures the most typical hardwood forest of APIS, found throughout most of the landscape in a broad range of environmental settings that display a wide range of vegetation characteristics. As the matrix forest, it is mostly found within mesic settings, yet it can be wet-mesic and is less common to dry-mesic settings. Forest canopy trees consist mostly of sugar maple, yellow birch, red maple, and paper birch. Other hardwoods, including American basswood, aspens (quaking and big-tooth), and northern red oak, are often present but in lesser amounts. Noteworthy is that the yellow birch can be less prominent due to various natural or human events (wind throws, logging) and is often replaced with paper birch. Canada yew can be of high density in the shrub layer, depending on past land use and deer populations.

Because the FMB map class spans a wide spectrum of environments, it easily transitions toward and closely resembles several other forest associations. The following discusses these proximities in more detail.

Hardwood Forests

Aspens (quaking and/or big-tooth) and paper birch trees can be a common canopy tree within FMB; however, when the combined RD of aspens and paper birch to other hardwoods was >75%, the Aspen - Birch / Sugar Maple - Mixed Hardwoods Forest (FAM) map class was considered. (Red maple was also to be part of this >75% RD formula; however, this was not understood by the mappers at the time of mapping.) Also, a scattering of American basswood trees can often be present. Yet, when the RD of canopy basswood to other hardwoods was >20% and yellow birch was essentially lacking, the Northern Maple - Basswood Forest (FMT) map class was considered. Furthermore, when the RD of canopy yellow birch to all other hardwoods was >90%, the Yellow Birch - (White Spruce) Forest (FYB) map class was considered. Lastly, we considered the Northern Red Oak - Sugar Maple Forest (FOM) map class when dry-mesic forests on southwest aspect hillsides or high elevations contained red oak having RD to other hardwoods of >25% or when, on all other aspects, dry-mesic forests contained red oak having RD to other hardwoods of >40%.

Mixed Hardwood-Conifer Forests

Common within FMB are conifers, including northern white-cedar, eastern hemlock, and balsam fir (white spruce is found less commonly); however, when the RD of conifers to hardwoods was >25%, with the RD of white-cedar to hemlock >50%, the White-cedar - Boreal Conifer Mesic Forest map class (two phases; FCC and FCM) was considered. In turn, when the RD of hemlock to white-cedar was >50%, the North - Central Hemlock - Hardwood Forest (FHM) map class was considered. Balsam fir dominance becomes a factor only when the hardwoods are primarily of paper birch, lacking significant sugar maple and yellow birch. For these scenarios, the Balsam Fir - Paper Birch Forest map class (two phases; FBF and FFB) was considered. Eastern white pine can also be present within FMB, yet it is usually scattered. Typically, when white pine becomes more present within hardwood forests, it is met with significantly more aspens and paper birch, such that the White Pine - Aspen - Birch Forest (FWA) map class was considered.

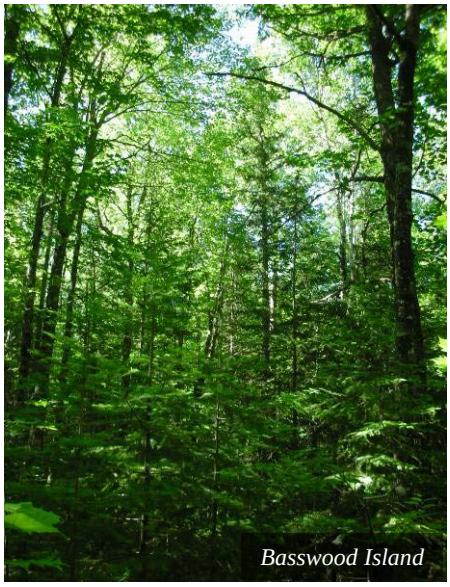
Mapping of FMB was frequent throughout APIS, mapped on both the mainland and all islands except Gull and Long, which are sandscape-derived islands. In fact, units of FMB are noticeably

absent on all sandscape locations. Also noteworthy is that much of the northern half of Devils Island—the most boreal-like environment of APIS—lacks units of FMB.

For AA, the FMB map class was assessed independently of all other map classes.



South Twin Island



Basswood Island



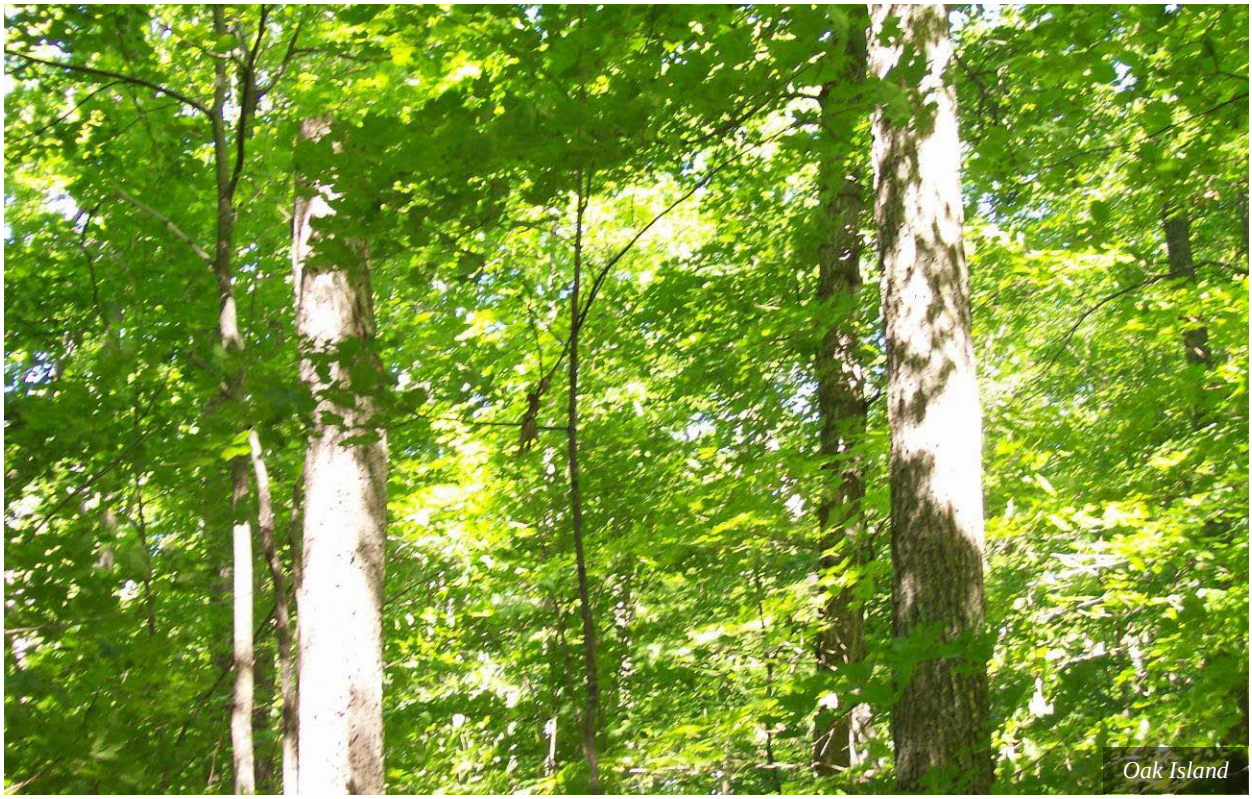
Michigan Island

Northern Maple - Basswood Forest (FMT)

The Northern Maple - Basswood Forest (FMT) map class represents the *Acer saccharum* - *Tilia americana* / *Ostrya virginiana* / *Lonicera canadensis* Forest Association (CEGL002458) in the NVCS. This map class captures a rare mesic hardwood forest of APIS, known only to the North Point Overlook area on Oak Island, which is the sole unit of FMT mapped. This forest type closely resembles the Maple - Yellow Birch Northern Hardwoods Forest (FMB) map class because it also is dominated by sugar maple; however, with the FMT map class, the RD of canopy American basswood to sugar maple and other hardwoods is >20%, while yellow birch is essentially lacking (allowing for only a minor shrub layer). Ironwood is the more typical shrub layer. When the RD of canopy basswood to all other hardwoods was <20%, the FMB map class was considered.

Mapping of the FMT map class was rare to APIS, with only one unit mapped—North Point Overlook on Oak Island.

For AA, the FMT map class was assessed independently of all other map classes.

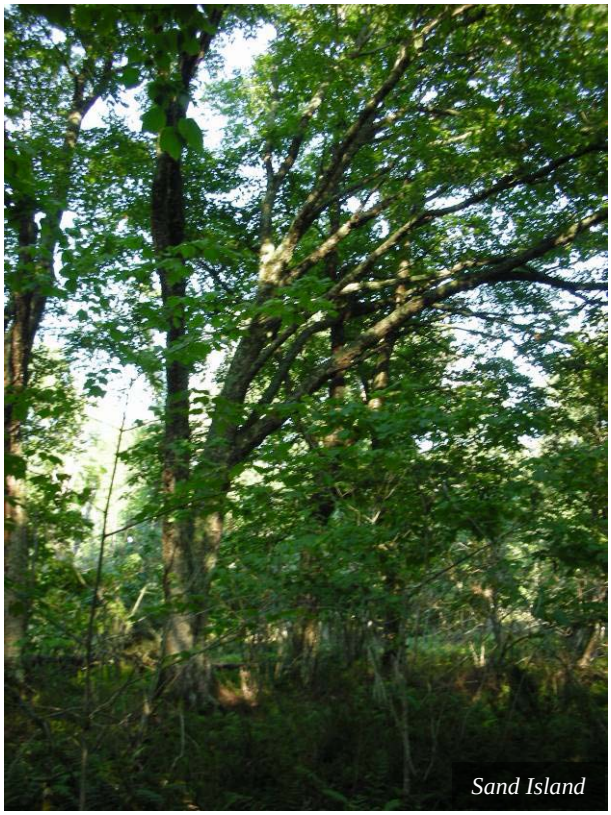

Oak Island

Yellow Birch - (White Spruce) Forest (FYB)

The Yellow Birch - (White Spruce) Forest (FYB) map class represents the *Betula alleghaniensis* - (*Acer saccharum*, *Picea glauca*) Forest [Provisional] Association (CEGL005245) in the NVCS. This map class captures a rare mesic hardwood forest of APIS, with just one unit mapped near the lighthouse on Sand Island. It is likely that more FYB exist, such as at the northern end of Outer Island; however, none of the FYB stands were determined greater than the area of a MMU. The FYB is exceedingly dominant, with the RD of canopy yellow birch to all other hardwoods >90% RD (with conifers a minor component at most). Very little or no sugar maple is present, with a RD to other hardwoods of <5%. When the RD of canopy yellow birch to all other hardwoods was <90%, particularly when the RD of sugar maple to all other hardwoods was >10%, the Maple-Yellow Birch Northern Hardwoods Forest (FMB) map class was considered.

Mapping of the FYB map class was rare to APIS, with only one unit mapped near the lighthouse on Sand Island.

For AA, the FYB map class was assessed independently of all other map classes.


Sand Island


Outer Island

Great Lakes White Pine - Hemlock Forest (FWH)

The Great Lakes White Pine - Hemlock Forest (FWH) map class represents the *Pinus strobus* - *Tsuga canadensis* Great Lakes Forest Association (CEGL002590) in the NVCS. This map class captures mesic conifer forests co-dominant with eastern white pine and eastern hemlock, each having >25% RD to each other. Hemlock is often greater in dominance, where white pine often forms a supracanopy over the hemlock. The RD of hardwoods to conifers is <25%, and red pine is a minor component at best. When the RD of red pine to hemlock and white pine was >25% RD, the White Pine / Mountain Maple Mesic Forest (FWM) was considered. Conversely, when the RD of white pine to hemlock was <25% RD, the Hemlock Mesic Forest (FHC) was considered, unless the RD of hardwoods to conifers was >25% RD, in which case the North-Central Hemlock - Hardwood Forest (FHM) was considered.

Mapping of the FWH map class was infrequent throughout APIS, mapped nominally on the four following islands: Bear, Cat, Otter, and Stockton.

For AA, the FWH map class was assessed independently of all other map classes.


Otter Island


Otter Island

Aspen - Birch - Red Maple Forest (FBR)

The Aspen - Birch - Red Maple Forest (FBR) map class represents the *Populus tremuloides* - *Betula papyrifera* - (*Acer rubrum*, *Populus grandidentata*) Forest Association (CEGL002467) in the NVCS. This map class captures dry, open forests of mixed deciduous trees and mixed shrubs on sand-ridge stringers of sandscapes between island lagoons and Lake Superior. Trees are usually of red maple and paper birch, with occasional presence of quaking aspen.

When pines (white pine, jack pine, red pine) and hardwoods each had >25% RD to each other, the appropriate pine-mixed hardwood map class was considered, depending on RD of the pines to each other.

Although mapping of the FBR map class was infrequent throughout APIS, they were most commonly mapped on the southeast half of Long Island and nominally mapped on the mainland at Sand Bay and on the sandscapes of the following five other islands: Michigan, Outer, Raspberry, Rocky, and Stockton.

For AA, the FBR map class was assessed independently of all other map classes.


Rocky Island


Long Island


Outer Island


Rocky Island

Aspen - Birch / Sugar Maple - Mixed Hardwoods Forest (FAM)

The Aspen - Birch / Sugar Maple - Mixed Hardwoods Forest (FAM) map class represents the *Populus tremuloides - Betula papyrifera* / *Acer saccharum* - Mixed Hardwoods Forest Association (CEGL002468) in the NVCS. This map class captures mesic forests when, as canopy trees, the RD of aspens (quaking and/or big-tooth) and paper birch to other hardwoods is >75% . (Red maple was also to be part of this >75% RD formula; however, this was not understood by the mappers at the time of mapping.) Sugar maple, yellow birch, northern red oak, and American basswood are minor components. The supracanopy of big-tooth aspen is not included in the formula, unless no forest canopy exists below it. Thus, if an aspen supracanopy was over a sugar maple-yellow birch canopy, the mapping would capture the forest with the Maple - Yellow Birch Northern Hardwoods Forest (FMB) map class. If a forest canopy did not exist below the aspen supracanopy, the mapping would capture the forest with the FAM map class. Also, when forest mixes of aspens, paper birch, red maple, yellow birch, and sugar maple were ambiguous, the FMB map class was strongly considered because these forests are accepted as an early successional stage of FMB. Also, when the RD of paper birch to all hardwoods was >90% (including aspens and red maples), the Paper Birch / Fir Forest (FPB) map class was considered.

The RD of conifer understory trees (usually consisting of balsam fir, northern white-cedar, and occasionally white spruce) and shrubs to deciduous trees is typically <20%. When balsam fir and white spruce shrubs were >25% total cover, the Aspen - Birch / Boreal Conifer Forest (FAC) map class was considered. (The FAC map class was used to capture such scenarios on the mainland unit only and not on islands.) However, when the RD of balsam fir to paper birch (aspens less common) was >25%, the Balsam Fir - Paper Birch Forest map class (two phases; FFB and FBF) was considered. When the RD of white-cedar to aspens, paper birch, and other associated hardwoods was >25%, the White-cedar - Boreal Conifer Mesic Forest map class (two phases; FCC and FCM) was considered.

Pine trees can be scattered throughout FAM; however, when the RD of pines to aspens, paper birch, and other associated hardwoods was >25%, a pine-aspen map class was considered. With the RD of hardwoods to conifers remaining at >25% RD, and when the RD of eastern white pine to other pines was >25% RD, the White Pine - Aspen - Birch Forest (FWA) map class was considered, regardless of sandscape or bedrock location. Likewise, when the RD of red pine to other pines was >75% RD, the Red Pine - Aspen - Birch Forest (FRA) map class was considered. When the RD of jack pine to red pine was >25% RD, yet the RD of white pine to all pines was <25% , the Jack Pine - Aspen / Bush-honeysuckle Forest (FJM) map class was considered (a class that was used only to map mesic sand pockets on Long Island).

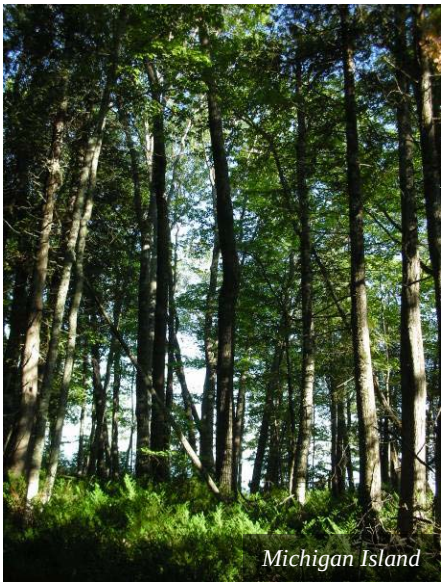
Mapping of the FAM map class was intermittent and patchy throughout APIS. Mapping of FAM was common to the mainland, often in concert with logging events. Some of these are almost monotypic fields of short-statured quaking aspen, even shrub-height. (These are attributed with a short height modifier.) Much of FAM mapped on the mainland is in the 400-m buffer beyond the APIS boundary. FAM was also mapped on a third of the archipelago. Most islands were mapped nominally or intermittently with FAM, whereas others, such as the southern half of Oak Island and the northwest margin of Basswood Island, were mapped more extensively.

For AA, the FAM map class was assessed independently of all other map classes.


Oak Island


Stockton Island


Stockton Island


Michigan Island

Northern Red Oak - Sugar Maple Forest (FOM)

The Northern Red Oak - Sugar Maple Forest (FOM) map class represents the *Quercus rubra* - *Acer saccharum* - (*Betula alleghaniensis*) Forest Association (CEGL002461) in the NVCS. This map class captures dry-mesic forests wherein the RD of northern red oak to other hardwoods is >25% when on southwest aspect hillsides and high elevation ridge tops or >40% when on all other aspects. Sugar maple is a strong component, with yellow birch, paper birch, and quaking aspen commonly present, however, when other mesic indicators existed, such as when balsam fir, northern white-cedar, and eastern hemlock became more prevalent in the shrub and subcanopy layers, the Maple - Yellow Birch Northern Hardwoods Forest (FMB) map class was likely considered. Recognizing that FOM is not a large matrix forest at the APIS, the mapping approach was conservative.

Mapping of the FOM map class was common but patchy throughout APIS. Most mapping of FOM was on almost a third of the archipelago. Many islands were mapped nominally or intermittently with FOM; however, mapping of FOM was common on islands of higher elevations, including Basswood, Oak, and Stockton. Most of all FOM mapped throughout the entire Lakeshore are on Oak Island and Stockton Island. FOM was mapped nominally on the mainland, with one unit mapped within the 400-m buffer beyond the APIS boundary.

For AA, the FOM map class was assessed independently of all other map classes.


Stockton Island


Bear Island

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) of the NVCS. This map class consists of two phases, 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 balsam fir and white spruce is >25% and to eastern hemlock is >50%. Balsam fir can be a primary component. Hardwoods typically consist of yellow birch, paper birch, and red maple and can have some element of sugar maple and American basswood. Eastern white pine can be scattered but its RD to all conifer trees should be <25%.

When the RD of conifers to hardwoods was <25%, the Maple - Yellow Birch Northern Hardwoods Forest (FMB) map class was likely considered. Also, when the RD of hemlock to white-cedar was >50%, the North-Central Hemlock - Hardwood Forest (FHM) map class was considered if the RD of hardwoods to conifers was also >25% RD. Alternatively, the Hemlock Mesic Forest (FHC) map class was considered if the RD of hardwoods to conifers was <25%. When in wetland sites, either the White-cedar - (Mixed Conifer) / Alder Swamp (FCS) map class or the White-cedar - Black Ash Swamp (FCA) map class was considered, depending on the RD of conifers and hardwoods to each other.

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, in part, 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% RD, the conifer - hardwood (FCM) phase of this same map class was considered. A significant amount of balsam fir may be present in the FCC phase, but its RD to northern white-cedar is <75%. Eastern hemlock may also be present, but its RD to white-cedar is <50%. Forests in the FCC phase are often dense with a shaded understory and a ground layer of sparse vegetation. The few hardwoods present are mostly of yellow birch and paper birch.

Mapping of the FCC map-class phase was somewhat infrequent throughout APIS. It was mapped somewhat commonly midway on the mainland and mapped in varying amounts to about half of the archipelago. Some islands have only nominal mapping of FCC, with only one or two units mapped. Other islands have intermittent mapping of FCC, some with areas mapped extensively, such as the northern portions of Cat and Raspberry Islands. Mapping of the FCC phase was not as extensive as that of the FCM phase.


Cat Island


Mainland

White-cedar - Boreal Conifer Mesic Forest (conifer - hardwood phase)–FCM

The conifer - hardwood (FCM) map-class phase represents, in part, 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 (as described above) was considered. Forests in the FCM phase are often less dense and more open than forest in the FCC phase and, thus, have richer understory vegetation.

Hardwood trees consist primarily of yellow birch and paper birch, although yellow birch can be less prominent because of various natural or human events (e.g., wind throws, logging) and is often replaced with paper birch. The hardwood tree canopy typically covers and obscures the conifer trees. To determine the correct forest type, it was essential to refer to spring, leaf-off aerial photographs during the mapping of the FCM phase in order to determine not merely the conifer component but also the RDs among conifer species (e.g., the RD of northern white-cedar to balsam fir).

Mapping of the FCM map-class phase was fairly frequent throughout APIS. The mapping of FCM was considerably more extensive than of FCC. Only four islands lack units of FCM, including Eagle, Gull, Long, and North Twin. Some islands have only nominal mapping of FCM, with only one or a few units mapped. Other islands have frequent mapping of the FCM phase, in some areas even indicating that FCM co-dominates with the matrix forest, the Maple - Yellow Birch Northern Hardwoods Forest (FMB). On the mainland, mapping was spotty, with units of FCM frequently mapped in the midway and eastern sections.



Basswood Island

Hemlock Mesic Forest (FHC)

The Hemlock Mesic Forest (FHC) map class represents the Tsuga canadensis - (*Betula alleghaniensis*) Forest Association (CEGL002598) in the NVCS. This map class captures mesic to wet-mesic conifer forests wherein the RD of eastern hemlock to northern white-cedar is >50%, the RD of eastern white pine to other conifers is <25%, and the RD of hardwoods to all conifers is <25%. When the RD of white pine to conifers with little or no red pine (a rare occurrence) was >25%, the Great Lakes White Pine - Hemlock Forest (FWH) map class was considered. When the RD of white-cedar to hemlock was >50% RD, the conifer (FCC) phase of the White-cedar - Boreal Conifer Mesic Forest map class was considered. Hardwoods consist mostly of yellow birch but can have some elements of red maple, paper birch, and sugar maple. When the collective RD of those hardwoods to conifers was >25%, the North-Central Hemlock - Hardwood Forest (FHM) map class was considered. Small pocket inclusions of the Hemlock - Yellow Birch Swamp Wet-Mesic Forest (FHS) are most probable within FHC.

Mapping of the FHC map class was infrequent throughout APIS, mapped nominally and intermittently on just over a third of the archipelago and on the mainland. The most distinguished stands of FHC were mapped on the northern end of Outer Island as part of the lighthouse preserve, which has never been logged. Notably, these stands are some of the only forests mapped at the APIS that received the 30–50-m height modifier (refers to average height of forest canopy). The other forests mapped with this height modifier were of FHM, again on the northern end of Outer Island.

For AA, the FHC map class was assessed independently of all other map classes.


Michigan Island


Oak Island

North-Central Hemlock - Hardwood Forest (FHM)

The North-Central Hemlock - Hardwood Forest (FHM) map class represents the *Tsuga canadensis - Acer saccharum - Betula alleghaniensis* Forest Association (CEGL005044) in the NVCS. This map class captures mesic to wet-mesic conifer-hardwood forests wherein the RD of eastern hemlock to northern white-cedar is >50%, the RD of eastern white pine to other conifers is <25%, and the RD of hardwoods to all conifers is >25% RD. Hardwoods consist mostly of yellow birch and sugar maple, and elements of red maple, paper birch, and quaking aspen are often present.

When the RD of hardwoods to conifers was >75%D, the Maple - Yellow Birch Northern Hardwoods Forest (FMB) map class was likely considered. When the RD of white pine to conifers was >25%, the White Pine - Aspen - Birch Forest (FWA) map class was considered, even when the aspen component might be nominal. When the RD of white-cedar to hemlock was >50%, the conifer - hardwood (FCM) phase of the White-cedar - Boreal Conifer Mesic Forest map class was considered. When the RD of hardwoods to conifers was <25%, the Hemlock Mesic Forest (FHC) map class was considered.

Mapping of the FHM map class was much more common throughout APIS than of FHC and was mapped on almost two-thirds of the archipelago and on the mainland. Some islands are only nominally mapped with FHM, such as on Hermit and York. Others are more commonly mapped with FHM throughout the island, such as on Manitou, Oak, and Stockton, and then there are other islands intermittently mapped (patchy yet significant) with FHM, such as on Basswood, Bear, Cat, Ironwood, Michigan, Otter, and Sand. The more distinguished units mapped of FHM are the on northern end of Outer Island, most as part of the lighthouse preserve, which has never been logged. Notably, these FHM units are some of the only forests mapped of APIS that received the 30–50-m height modifier (refers to average height of forest canopy). The other forests mapped with this height modifier were of FHC, again on the northern end of Outer Island. Prominent as well on Outer Island is the apparent change in forests running east to west through the middle of the island, with FHM frequent to the north and only intermittent to the south. This pattern of cover is largely in response to the southern half of the island being logged, clear-cutted, and subsequently burned during the early 20th century. The northern half of the island was selectively cut for hardwoods near the middle of the century, leaving numerous relic stands of hemlock (Howk 2001).

For AA, the FHM map class was assessed independently of all other map classes.



Outer Island



Basswood Island



Oak Island

Jack Pine - Northern Pin Oak Forest (FJO)

The Jack Pine - Northern Pin Oak Forest (FJO) map class represents the *Pinus banksiana* - (*Pinus resinosa*) - *Quercus ellipsoidalis* / *Carex pensylvanica* Forest Association (CEGL002478) of the NVCS. This map class captures dry, open forests on the sand ridges of Long Island that are dominated by jack pine and northern pin oak, even when oak trees are scrub and subcanopy. FJO is known to be present only to the far western end of Long Island. The mutual RD of conifers and hardwoods is >25%, with a RD of jack pine to eastern white pine and red pine of >50%, yet with a RD of white pine to all pines of <25%. With the RD of hardwoods to conifers remaining >25%, when the RD of eastern white pine to all pines was >25%, the White Pine - Aspen - Birch Forest (FWA) map class was considered, particularly when the hardwoods were more dense with paper birch and red maple and less so with pin oak. Likewise, with jack pine remaining the dominant pine, when hardwoods were less with northern pin oak and more with paper birch, red maple, and quaking aspen within wet-mesic sand pockets having wetland vegetation (e.g., gray alder, sweetgale, sedge, bluejoint), the Jack Pine - Aspen / Bush-honeysuckle Forest (FJM) map class was considered.

The FJO is in close proximity with the Jack Pine / Blueberry /Feathermoss Forest (FJB) and the Northern Pin Oak - (Bur Oak) Forest (FPO), both known only on the western half of Long Island as well. When the RD of pin oak to jack pine was <25% and blueberry shrubs were more prominent within the sand swales on Long Island, the FJB map class was considered. When the RD of jack pine to pin oak was <25% and when the RD of other hardwoods to the pin oak was <25%, the FPO map class was considered.

Not only was mapping of the FJO map class rare to APIS as a whole, but also to Long Island (the only island mapped with FJO). Only a handful of FJO units were mapped on the western half of the island.

For AA, the FJO map class was assessed independently of all other map classes.


Long Island


Long Island


Long Island

Red Pine - Aspen - Birch Forest (FRA)

The Red Pine - Aspen - Birch Forest (FRA) map class represents the *Pinus resinosa* - *Populus tremuloides* / *Diervilla lonicera* - *Vaccinium* spp. Forest Association (CEGL002520) in the NVCS. This map class captures dry-mesic mixed conifer and hardwood forests wherein the RD of red pine to other conifers is >75% RD. The RD of hardwoods to conifers is >25%, and hardwoods consist of varying amounts of red maple, aspens (quaking and/or bigtooth), paper birch, and some northern red oak. Although these forests tend to be dry-mesic, an element of balsam fir can be present.

When the RD of hardwoods to conifers was >75%, either the Aspen - Birch / Sugar Maple - Mixed Hardwoods Forest (FAM) map class or the Maple - Yellow Birch Northern Hardwoods Forest (FMB) map class was considered. Conversely, when the RD of hardwoods to conifer trees was <25%, with the RD of red pine to other conifers remaining at >75%, the Red Pine / Blueberry Dry Forest (FRP) map class was considered. However, when the RD of red pine to other conifers was <75%, then other mixed conifer-hardwood map classes were considered, including White Pine - Aspen - Birch Forest (FWA) and Jack Pine - Aspen / Bush-honeysuckle Forest (FJM).

Mapping of the FRA map class was rare throughout APIS, mapped on just two islands, Oak and Stockton. On Oak Island, one mapped unit of FRA is on bedrock located on the far southwest corner of the island. Three other units of FRA are mapped on Stockton Island just within the tombolo sandscape. Noteworthy is that vegetation plots of FRA were collected in both sandscape and bedrock locations, although mapping did not capture these plot locations because they were less than the area of a MMU.

For AA, the FRA map class was assessed independently of all other map classes.


Michigan Island

Red Pine / Blueberry Dry Forest (FRP)

The Red Pine / Blueberry Dry Forest (FRP) map class represents the *Pinus resinosa* / *Vaccinium* spp. Forest Association (CEGL002443) in the NVCS. This map class captures dry to dry-mesic forests that are strongly dominated by red pine, either on bedrock or sandscapes. The RD of Red pine to other conifers is >75%, with a RD of hardwoods to conifers <25%. An element of aspens (quaking and/or bigtooth) and paper birch can be in the subcanopy.

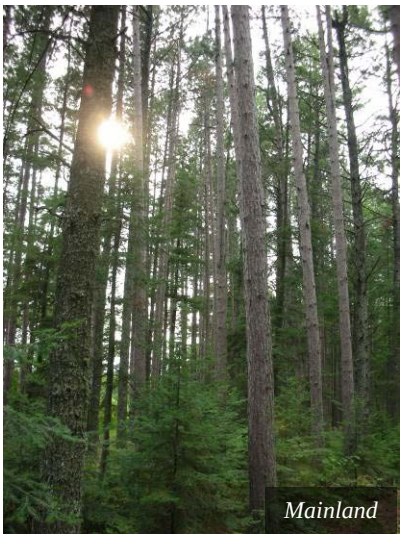
When the RD of hardwoods to conifers was >25% while the RD of red pine to other conifers was >75%, the Red Pine-Aspen-Birch Forest (FRA) map class was considered. Otherwise, when the RD of red pine to all conifers was <75%, other conifer-forest map classes were considered as follows: (1) the White Pine / Mountain Maple Mesic Forest (FWM) map class was considered when the RD of eastern white pine to conifers was >25% and the forest was on bedrock; (2) the White Pine / Blueberry Dry-Mesic Forest (FWP) map class was considered when the RD of eastern white pine to red pine and jack pine was >25% and the forest was on sandscape; (3) the Jack Pine / Blueberry / Feathermoss Forest (FJB) map class was considered when jack pine was dominant and the forest was on sandscape; and (4) the Black Spruce / Feathermoss Forest (FBS) map class was considered when the RD of black spruce to red pine was >25%, a scenario common to higher sands of the Stockton Island tombolo. Furthermore, the Great Lakes Dune Pine Forest (FPD) was considered when red pine-dominant forests were on active sand dunes, foredunes, and sand ridge stringers.

Mapping of the FRP map class was intermittent throughout APIS. On the mainland, units of FRP were mapped rarely, with one forest on bedrock above some sea caves and another two forests in sandscape settings. On islands, units of FRP were mapped only to sandscape environments on the following three islands: Long, the sandspit of Michigan, and the tombolo of Stockton.

For AA, the FRP map class was assessed independently of all other map classes.


Mainland


Stockton Island


Mainland

White Pine - Aspen - Birch Forest (FWA)

The White Pine - Aspen - Birch Forest (FWA) map class represents the *Pinus strobus - Populus tremuloides* / *Corylus cornuta* Forest Association (CEGL002479) in the NVCS. This map class captures mesic to dry-mesic mixed conifer and hardwood forests wherein the RD of eastern white pine to other conifers is >25%. The RD of hardwoods to conifers are >25%, and hardwoods consist of paper birch with varying amounts of red maple, sugar maple, basswood, and aspens (quaking and/or big-tooth). Northern red oak is only nominally present or absent. White pine is often supracanopy above the hardwood forest canopy. A significant amount of red pine can be present, particularly in the dry-mesic sites. These forests often have an element of balsam fir and northern white-cedar present.

When the RD of red pine to other conifers was >75%, the Red Pine - Aspen - Birch Forest (FRA) map class was considered. When the RD of hardwoods to conifers was >75%, either the Aspen - Birch / Sugar Maple - Mixed Hardwoods Forest (FAM) map class or the Maple - Yellow Birch Northern Hardwoods Forest (FMB) map class was considered. Conversely, when the RD of hardwoods to conifers was <25%, either the White Pine / Blueberry Dry-Mesic Forest (FWP) map class (when on sandscape) or the White Pine / Mountain Maple Mesic Forest (FWM) map class (when on bedrock) was considered.

Mapping of the FWA map class was intermittent throughout APIS, mapped on the mainland and on over half of the archipelago. FWA mapping was frequent to sandscape environments and to bedrock sites along the margins of several islands. Rarely was FWA mapped landward on islands, although it was intermittently mapped landward on the mainland.

For AA, the FWA map class was assessed independently of all other map classes.


Outer Island


Michigan Island

White Pine / Mountain Maple Mesic Forest (FWM)

The White Pine / Mountain Maple Mesic Forest (FWM) map class represents the *Pinus strobus* / *Acer spicatum* - *Corylus cornuta* Forest Association (CEGL002445) in the NVCS. This map class captures eastern white pine mesic forests on bedrock wherein the RD of white pine to other conifers (particularly other pines) is >25% and wherein the RD of hardwoods to conifers is <25%. Other component trees often consist of red pine (in dryer sites) and hemlock and northern white-cedar (in moister sites). Characteristic of the FWM map class is balsam fir and a significant tall-shrub layer.

When the RD of red pine to all conifers was >75%, the Red Pine / Blueberry Dry Forest (FRP) map class was considered. When the RD of eastern hemlock to white pine was >25%, the Great Lakes White Pine - Hemlock Forest (FWH) map class was considered. When occurring on sandscape locations and when the RD of white pine to conifers (particularly red pine and jack pine) was >25%, the White Pine / Blueberry Dry - Mesic Forest (FWP) map class was considered. Furthermore, when the RD of hardwoods to conifers was >25%, the White Pine - Aspen - Birch Forest (FWA) map class was considered.

Mapping of the FWM map class was rare to APIS, with only two units mapped—one on Devils Island and one on Otter Island.

For AA, the FWM map class was assessed independently of all other map classes.

No representative pictures were available.

White Pine / Blueberry Dry-Mesic Forest (FWP)

The White Pine / Blueberry Dry-Mesic Forest (FWP) map class represents the *Pinus strobus* / *Vaccinium* spp. Forest Association (CEGL002444) in the NVCS. This map class captures eastern white pine dry-mesic to dry forests on sandscape locations, barring active dunes and sand-ridge stringers between lagoons and Lake Superior. When occurring on bedrock locations, the White Pine / Mountain Maple Mesic Forest (FWM) map class was considered. The FWP can be both open and closed canopy and lacks a tall-shrub understory. The RD of hardwoods to conifers is <25%, and the RD of white pine to all conifers (particularly other pines) is >25%.

When the RD of white pine to red pine and/or jack pine was <25%, either the Red Pine / Blueberry Dry Forest (FRP) map class (when the RD of red pine to all other conifers was > 75%) or the Jack Pine / Blueberry / Feathermoss Forest (FJB) map class (when the RD of jack pine to other conifers, primarily pines, was >25%) was considered. Furthermore, when the RD of hardwoods to conifers was >25%, the White Pine - Aspen - Birch Forest (FWA) map class was considered, regardless of whether or not the forest was located in a sandscape location.

When tree canopy was >60% cover, regardless of pine component densities, and were on active sand dunes or sand ridge stringers between sandscape lagoons and Lake Superior, the Great Lakes Dune Pine Forest (FPD) map class was considered. Likewise, when tree canopy was <60% cover, either the woodland (HPW) phase or the barrens (HPB) phase of the Great Lakes Coast Pine Barrens map class was considered, depending on density of canopy cover.

Mapping of the FWP map class was infrequent throughout APIS. FWP was mapped only in localized sandscape areas of the following four islands: Bear, Long, Outer, and Stockton. FWP mapped on Stockton Island were associated with the tombolo, whereas those on Bear Island and Outer Island are part of the sand spit at the southern tip of each of those islands. Those on Long Island are located on the western half near the lighthouse.

For AA, the FWP map class was assessed independently of all other map classes.


Bear Island


Outer Island

Northern Pin Oak - (Bur Oak) Forest (FPO)

The Northern Pin Oak - (Bur Oak) Forest (FPO) map class represents the *Quercus ellipsoidalis* - (*Quercus macrocarpa*) Forest Association (CEGL002077) in the NVCS. This map class captures dry to dry-mesic forests wherein northern pin oak dominates, which are only known to exist on the west half of Long Island at the APIS. The RD of northern pin oak to other hardwoods (including paper birch and red maple) is >75%. Forests in the FPO map class are in close proximity to those in the Jack Pine - Northern Pin Oak Forest (FJO) map class, because they share much the same environmental regime on Long Island. When the RD of jack pine to northern pin oaks was >25% and the RD of other hardwoods to the pin oaks was <25% RD, the FJO map class was considered. Likewise, on Long Island when the RD of pines to the hardwoods was >25% and the RD of eastern white pine to all other pines was >25%, the FWA map class was considered, particularly when the hardwoods were more dense with paper birch and red maple and less so with northern pin oak.

Not only was mapping of the FPO map class rare to APIS as a whole, but also to Long Island (the only island mapped with FPO). Only two FPO units were mapped on the western half of Long island.

For AA, the FPO map class was assessed independently of all other map classes.


Long Island


Long Island

Great Lakes Dune Pine Forest (FPD)

The Great Lakes Dune Pine Forest (FPD) map class represents the *Pinus banksiana - Pinus resinosa - Pinus strobus* Dune Forest Association (CEGL002589) of the NVCS. This map class captures red pine, eastern white pine, and/or jack pine forests with tree canopy >60% cover and are on active sand dunes, foredunes, and sand ridges, including the built-up sand ridges (stringers) between island lagoons and Lake Superior. The Great Lakes Coast Pine Barrens map class (two phases, HPB and HPW) captures those stands with tree canopy <60% cover. The understory vegetation is of typical sandscape species, such as American beachgrass, sand cherry, common juniper, bearberry, and woolly beach-heather. The RD of the hardwood tree component to conifer trees is <25%.

When pine forests on sandscapes were elsewhere than on active sand dunes and on built-up sand ridges (inland sands), other pine-dominant map classes associated to sandscapes were considered, including White Pine / Blueberry Dry-Mesic Forest (FWP), Jack Pine / Blueberry / Feathermoss Forest (FJB), and Red Pine / Blueberry Dry Forest (FRP), depending on RD of pines. When pine forests anywhere on sandscapes were mixed with hardwoods such that the RD of the latter was >25%, mixed map classes of pine and hardwoods were considered, including Jack Pine - Northern Pin Oak Forest (FJO), Jack Pine - Aspen / Bush-honeysuckle Forest (FJM), White Pine - Aspen - Birch Forest (FWA), and Red Pine - Aspen - Birch Forest (FRA).

Mapping of the FPD map class was rare to APIS, with three units mapped on the sandspit of Outer Island and a pair of units mapped on the tombolo of Stockton Island.

For AA, the FPD map class was assessed independently of all other map classes.


Stockton Island


Stockton Island

Hardwood Ruderal Forest (FDX)

The Hardwood Ruderal Forest (FDX) map class represents, in part, the Northern & Central Hardwood & Conifer Ruderal Forest Group (G030) of the NVCS. Due to disturbance from human activity and the inherent variability of floristic vegetation of these early successional forests, an association type could not be determined. This map class captures ruderal forests with >25% tree cover and wherein the RD of hardwoods to conifers is >75%. Hardwoods consist of deciduous tree species, some common to other areas and some unique to APIS area. These ruderal forests can be open or closed canopy.

When the RD of conifers to hardwoods was >25%, the Conifer-Hardwood Ruderal Forest (FMX) map class was considered, which also represents, in part, the Northern & Central Hardwood & Conifer Ruderal Forest Group (G030) of the NVCS. Also, when trees made up <25% cover, either the Deciduous Ruderal Shrubland (SDX) map class or the Conifer - Deciduous Ruderal Shrubland (SMX) map class was considered, depending on RD of conifer and deciduous shrubs. Furthermore, when trees and shrubs together made up <25% cover, the Ruderal Grassland (HMX) map class was considered.

Mapping of the FDX map class was somewhat uncommon throughout APIS, with units mapped on the mainland mostly in the 400 m buffer beyond the APIS boundary; most of these locations are in response to logging events. When mapped on islands, mapping of FDX was of successional forests associated to homestead sites or APIS structures (e.g., behind the lighthouse on Raspberry Island). Of most unique is the ruderal successional forest of the old air strip on South Twin Island.

Because of the variability of vegetation inherent to ruderal forests, the FDX map class was not assessed for accuracy.

No representative pictures were available.

Conifer - Hardwood Ruderal Forest (FMX)

The Conifer - Hardwood Ruderal Forest (FMX) map class represents, in part, the Northern & Central Hardwood & Conifer Ruderal Forest Group (G030) in the NVCS. Due to disturbance from human activity and the inherent variability of floristic vegetation of these early successional forests, an association type could not be determined. This map class captures ruderal forests having >25% tree cover with conifers and hardwoods, each having RD of >25% to each other. Conifers and hardwoods consist of some tree species common to other areas and some unique to the APIS area. These ruderal forests can be open or closed canopy.

When the RD of conifers to hardwoods was <25%, the Hardwood Ruderal Forest (FDX) map class was considered, which also represents, in part, the Northern & Central Hardwood & Conifer Ruderal Forest Group (G030) in the NVCS. Also, when trees made up <25% cover, either the Deciduous Ruderal Shrubland (SDX) map class or the Conifer - Deciduous Ruderal Shrubland (SMX) map class was considered, depending on RD of conifer and deciduous shrubs. Furthermore, when trees and shrubs together made up <25% cover, the Ruderal Grassland (HMX) map class was considered.

Mapping of the FMX map class was somewhat uncommon throughout APIS, with units mapped on the mainland mostly in the 400-m buffer beyond the APIS boundary (most of these locations are in response to logging events). When mapped on islands, FMX was of successional forests associated to homestead sites. The most unique mapping of FMX was of the ruderal successional forest on the old air strip on South Twin Island.

Because of the variability of vegetation inherent to ruderal forests, the FMX map class was not assessed for accuracy.



South Twin Island

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 one conifer evergreen tree plantation consisting of spruce. The sole unit of FPE was mapped in the 400-m area beyond the APIS boundary just west of Meyers Beach.

Because of the cultivated disposition of being a plantation, the FPP map class was not assessed for accuracy.

No representative pictures were available.

Red Maple - Ash - Birch Swamp Forest (FRM)

The Red Maple - Ash - Birch Swamp Forest (FRM) map class represents the *Acer rubrum* - *Fraxinus* spp. - *Betula papyrifera* / *Cornus canadensis* Forest Association (CEGL002071) in the NVCS. This map class typically captures wetland forests along peatland-basin margins and within beaver meadows, often as they become inactive. Hardwoods consist of red maple, commonly with yellow birch and paper birch. Some northern white-cedar and eastern white pine may be present. A wetland forest, the canopy is usually open, and trees are often of short stature. The understory vegetation is often of bluejoint and sedges, with some element of alder shrubs; however, because of hydrology changes from beaver influence, floristic vegetation can be highly variable from one stand to another.

When the RD of black ash to all hardwoods was >25%, the Black Ash - Mixed Hardwood Swamp (FBA) map class was considered. When the RD of white-cedar to hardwoods was >25%, the White-cedar - Black Ash Swamp (FCA) map class was considered. When hardwoods made up <25% canopy cover, then shrub and herbaceous map classes were considered, including Gray Alder Swamp Shrubland (SAS), Wet Meadow Mixed Herbaceous (HWM), Bluejoint Wet Meadow (HCC), and Northern Sedge Wet Meadow (HSG).

Mapping of the FRM map class was intermittent and scattered throughout APIS, mapped in varying amounts on less than a third of the archipelago and nominally on the mainland. Interestingly, mapping of FRM was most extensive on Outer Island, where many beaver meadows have become inactive. On Sand Island and Stockton Island, FRM was mapped almost as extensively as on Outer Island, yet in these locations FRM was more associated with margins of peatland basins. On the eastern half of Michigan Island, FRM was mapped at sites associated with beaver meadows and margins of peatland basins. Other than these locations, FRM was mapped nominally on Rocky Island (southern edge) and on the mainland (within Sand Bay).

For AA, the FRM map class was assessed independently of all other map classes.


Outer Island


Michigan Island



Outer Island



Outer Island

Black Ash - Mixed Hardwood Swamp (FBA)

The Black Ash - Mixed Hardwood Swamp (FBA) map class represents the *Fraxinus nigra* - Mixed Hardwoods - Conifers / *Cornus sericea* / *Carex* spp. Forest Association (CEGL002105) of the NVCS. This map class captures wetland forests wherein the RD of black ash to other hardwoods is >25% and the RD of conifers to hardwoods is <25%. Other present hardwoods may consist of red maple, yellow birch, and paper birch. Conifers may consist of northern white-cedar and balsam fir and are often of short stature, yet all conifer trees have a RD to hardwoods of <25%. The forest canopy can be open, with a significant gray alder shrub understory. Typical settings range from wet-mesic drainages to wetland margins of peatland basins.

When the RD of black ash to other hardwoods (with red maple being primary) was <25%, the Red Maple - Ash - Birch Swamp Forest (FRM) map class was considered; however, when hardwoods made up <25% canopy cover and alder shrubs made up >25% cover, the Gray Alder Swamp Shrubland (SAS) map class was considered. When the RD of conifers to hardwoods was >25% and the RD of white-cedar to conifers was >25%, the White-cedar - Black Ash Swamp (FCA) map class was considered.

Mapping of the FBA map class was intermittent and scattered throughout APIS, mapped in varying amounts on less than a third of the archipelago, yet extensively mapped within three localized areas on the mainland. The largest mapping extent of FBA was on the mainland in the Sand Bay area. Mapping of FBA was somewhat extensive to several small drainage corridors located among the western and the eastern portions of the mainland. A significant amount of FBA was also mapped on the eastern half of Sand Island—just north of the mainland. Otherwise, nominal expressions of FBA were mapped on only a few other islands, including Basswood, Cat, Michigan, and Stockton.

For AA, the FBA map class was assessed independently of all other map classes.


Sand Island


Cat Island

White-cedar - Black Ash Swamp (FCA)

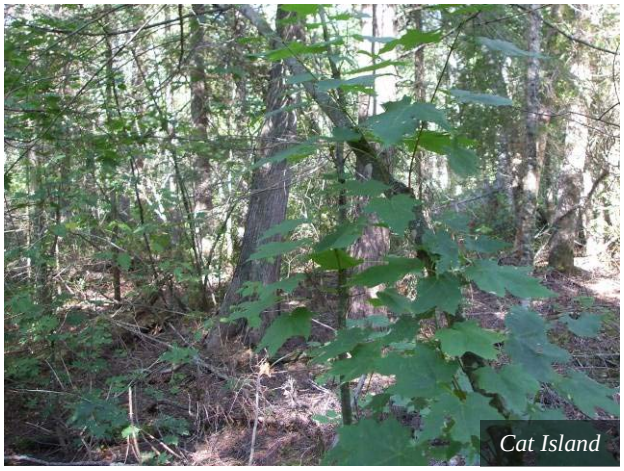
The White-cedar - Black Ash Swamp (FCA) map class represents the *Thuja occidentalis* - *Fraxinus nigra* Forest Association (CEGL005165) in the NVCS. This map class captures mixed conifer and hardwood wetland forests wherein the RD of northern white-cedar to other conifers is >25% and the RD of black ash to other hardwoods is >25% (although the black ash is sometimes diminished and more dominant with red maple). Typical settings range from wet-mesic drainages to wetland margins of peatland basins. Red maple, yellow birch, paper birch, and balsam fir are common component trees, with gray alder a common shrub, particularly when forest canopy is open. The white-cedar can often be obscured by a slightly taller black ash canopy; therefore, the use of spring, leaf-off aerial photographs was helpful in determining FCA from Black Ash - Mixed Hardwood Swamp (FBA) during mapping.

When the RD of hardwoods to conifers was <25%, the White-cedar - (Mixed Conifer) / Alder Swamp (FCS) map class was considered. Likewise, when the RD of conifers to hardwoods was <25%, the Black Ash - Mixed Hardwood Swamp (FBA) map class was considered. Also, within mesic-wet sites, when black ash was diminished and replaced with yellow birch and paper birch, the conifer - hardwood (FCM) phase of the White-cedar - Boreal Conifer Mesic Forest map class was considered.

Mapping of the FCA map class was infrequent throughout APIS—much less frequent than of FBA, although often in close proximity to FBA. The largest extent of FCA was mapped on the mainland in the Sand Bay area. Otherwise, nominal expressions of FBA were mapped of other locations on the mainland and only on two islands, including Sand and Cat.

For AA, the FCA map class was assessed independently of all other map classes.


Mainland


Cat Island

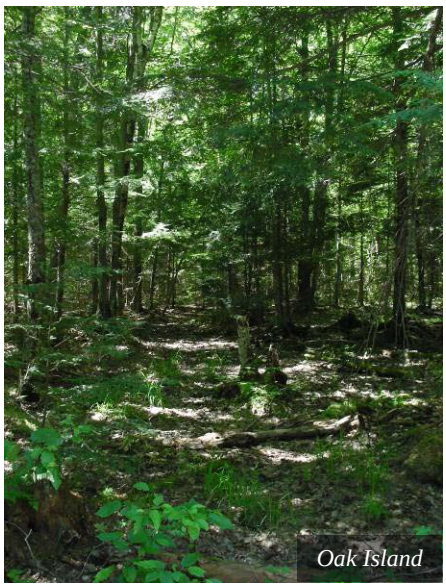
Hemlock - Yellow Birch Swamp Wet-Mesic Forest (FHS)

The Hemlock - Yellow Birch Swamp Wet-Mesic Forest (FHS) represents the *Tsuga canadensis - Betula alleghaniensis* Saturated Forest Association (CEGL005003) in the NVCS. This map class captures eastern hemlock wetland forests wherein the RD of hemlock cover to all other trees is >25%, with the RD of northern white-cedar to hemlock is <50%, and the RD of black spruce to hemlock is <25%. Other trees in addition to white-cedar are typically present, including red maple, white pine, black spruce, and yellow birch. Typical settings range from saturated wet drainages to small wetland basins. Sphagnum and other peatland vegetation such as Labrador-tea is often a common component of the ground layer.

When the RD of white-cedar to hemlock was >50%, the White-cedar - (Mixed Conifer) / Alder Swamp (FCS) map class was considered. Likewise, when the RD of black spruce to all other conifers within these wetland settings was >25%, the Black Spruce - Tamarack / Labrador-tea Poor Swamp map class (two phases, FSS and FTP) was considered. Particularly within wet-mesic settings, there can be a subtle transition between FHS and upland hemlock forests, such that when mapping FHS, both the Hemlock Mesic Forest (FHC) and the North-Central Hemlock - Hardwood Forest (FHM) map classes were kept in mind, depending on the amount of hardwoods present. Pockets of FHS smaller than the area of a MMU likely exist within areas mapped as FHM.

Mapping of the FHS map class was somewhat unique throughout APIS, mapped mostly on Stockton Island, with nominal examples on a few other islands, including Bear, Cat, Manitou, Oak, and Outer. Interestingly, the FHS on Oak Island is located near center of the island at one the higher elevations within APIS. No units of FHS were mapped on the mainland.

For AA, the FHS map class was assessed independently of all other map classes.


Oak Island


Cat Island

Gray Alder Swamp Shrubland (SAS)

The Gray Alder Swamp Shrubland (SAS) represents the *Alnus incana* Swamp Shrubland Association (CEGL002381) in the NVCS. It is worth pointing out that although SAS is a shrubland, it is located within the Forest & Woodland Class hierarchy of the NVCS. This map class captures wetland shrublands having >25% shrub cover, with a RD of gray alder to shrubs of >25%. These alder shrub wetlands are common to saturated drainages and margins of peatland basins; however, when in shore fen environments (e.g., sandscapes), the Alder-Willow Shore Fen (SAW) map class was considered.

The typic expression of these shrub wetlands are tall, dense stands of monotypic alder, with a few other shrub species (such as willows). Hardwoods, such as red maple and black ash, can be present, along with yellow birch and paper birch; however, when hardwoods made up >25% cover, the Red Maple - Ash - Birch Swamp Forest (FRM) or the Black Ash - Mixed Hardwood Swamp (FBA) map class was considered, depending on RD of hardwood components. Likewise, when conifers made up >25% cover and the RD of northern white-cedar to other conifers (e.g., black spruce, tamarack, balsam fir) was >25%, the White-cedar - (Mixed Conifer) / Alder Swamp (FCS) map class was considered. Also, when conifers and hardwoods combined made up >25% cover, and black ash and white-cedar each met their density criteria for the White-cedar - Black Ash Swamp (FCA), the FCA map class was considered.

Mapping of the SAS map class was intermittent throughout APIS, mapped at three localized areas on the mainland in varying amounts and on the four following islands: Michigan, Outer, Sand, and Stockton. On the mainland, SAS was mapped extensively in the Sand Bay area, as it intertwines with black ash swamps. SAS was also mapped at the Little Sand Bay and Meyers Beach areas, although not as extensively. As for islands, SAS was mapped somewhat occasional on the following three islands: the eastern half of Michigan Island, in close association with the peatland and beaver complexes; Sand Island; and Stockton Island. Most notable on Sand Island is the extensive moat of alder surrounding the large complex of black spruce-tamarack peatland located at the northeastern corner of the island, south of the lighthouse. SAS was mapped nominally on Outer Island, associated with beaver meadows.

For AA, the SAS map class was assessed independently of all other map classes.


Sand Island


Sand Island


Sand Island

Black Spruce / Feathermoss Forest (FBS)

The Black Spruce / Feathermoss Forest (FBS) map class represents the *Picea mariana* / *Pleurozium schreberi* Forest Association (CEGL002447) in the NVCS. This map class captures black spruce forests in upland settings with a prominent feathermoss ground layer. The RD of eastern white pine to all conifers is <25%, and the RD of black spruce to conifers is >25%. Red pine is a common associate; however, when the RD of red pine to conifers was >75%, the Red Pine / Blueberry Dry Forest (FRP) map class was considered. At the APIS, FBS is known only to Stockton Island on the tombolo.

When sites were made up of floristics common to peatlands (e.g., sphagnum, ericads), even on wet-mesic to mesic sites (e.g., on Devils Island), the Black Spruce - Tamarack / Labrador-tea Poor Swamp map class (two phases, FSS and FTP, with FSS most probable in this scenario) was considered.

Mapping of the FBS map class was rare to APIS and was mapped only at the more developed areas of the double tombolo on Stockton Island.

For AA, the FBS map class was assessed independently of all other map classes.


Stockton Island


Stockton Island

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) of the NVCS. This map class captures jack-pine mixed hardwood forests of wet-mesic sand pockets and is known to exist only at the far western end of Long Island. The mutual RD of conifers and hardwoods is >25%; the RD of jack pine to eastern white pine and red pine is >50%; and the RD of white pine to all pines is <25%. Hardwoods consist mostly of paper birch and red maple, with some quaking aspen; however, aspen is not always present. Northern pin oak is lacking or minimal at best.

The FJM can range from open canopy, shrub-height trees that are scattered evenly throughout the basin to closed canopy, mid-sized trees at the margins of smaller shrub wetland pockets (consisting of gray alder, sweetgale, sedges, bluejoint). These wetland pockets are smaller than the area of a MMU; thus, areas of Alder - Willow Shore Fen (SAW) may be found within mapped areas of FJM.

When the RD of northern pin oak to all other hardwoods (particularly on dry sites) was >25%, the Jack Pine - Northern Pin Oak Forest (FJO) map class was considered. Similarly, at dry sites within sandy swales and with a blueberry understory, the Jack Pine / Blueberry / Feathermoss Forest (FJB) map class was considered when the RD of hardwoods to conifers (dominated by jack pine) was <25%. It is worth noting, however, that like FJM, FJO and FJB are only known to exist at the western half of Long Island. Also on Long Island, sites on sandy ridge-like dunes wherein the RD of hardwoods to conifers was <25%, either the woodland (HPW) phase (when canopy was >25% cover) or the barrens (HPB) phase (when canopy was 25–60% cover) of the Great Lakes Coast Pine Barrens map class was considered.

Not only was mapping of the FJM map class rare to APIS as a whole, but also to Long Island (the only island mapped with FJM). Only a handful of FJM units were mapped on the western half of the Long Island.

For AA, the FJM map class was assessed independently of all other map classes.


Long Island

Jack Pine / Blueberry / Feathermoss Forest (FJB)

The Jack Pine / Blueberry / Feathermoss Forest (FJB) map class represents the *Pinus banksiana* / *Vaccinium* spp. / *Pleurozium schreberi* Forest Association (CEGL002441) of the NVCS. This map class captures dry to dry-mesic forests within sandy swales that are dominated by jack pine and that are only known to exist at the western end of Long Island. The RD of Jack pine to eastern white pine and red pine is >50%, and the RD of white pine to all other pines is <25%. When the RD of white pine to other pines is >25%, the White Pine / Blueberry Dry-Mesic Forest map class was considered. The FJB is typically open canopy with significant blueberry vegetation in the understory. FJB forests surround or are surrounded by deeper swale shrub wetlands of gray alder, sweetgale, and leatherleaf. Likewise, FJB forests flank the Great Lakes Coast Pine Barrens, both the woodland (HPW) and the barrens (HPB) phases. The RD of hardwoods to conifers is <25%.

When sites were on sandy ridge-like dunes with more sandscape vegetation (e.g., woolly beach-heather, common juniper), even with jack pine as the dominant pine, either the HPW phase of the Great Lakes Coast Pine Barrens map class (when tree canopy was 25–60% cover) or the HPB phase of the same map class was considered (when tree canopy was <25% cover). When the RD of dominant northern pin oak hardwoods to dominant jack pine conifers was >25%, the Jack Pine - Northern Pin Oak Forest (FJO) map class was considered; however, when hardwoods were of paper birch, red maple, and quaking aspen within wet-mesic sand pockets having wetland vegetation (e.g., gray alder, sweetgale, sedges, bluejoint), the Jack Pine - Aspen / Bush-honeysuckle Forest (FJM) map class was considered. Like FJB, FJO and FJM are only known to exist at the western half of Long Island.

Not only was mapping of the FJB map class rare to APIS as a whole, but also to Long Island (the only island mapped with FJB). Only a handful of FJB units were mapped at the western half of Long Island.

For AA, the FJB map class was assessed independently of all other map classes.


Long Island


Long Island

Balsam Fir - Paper Birch Forest (FBF and FFB)

The Balsam Fir - Paper Birch Forest map class represents the *Abies balsamea - Betula papyrifera / Diervilla lonicera* Forest Association (CEGL002474) in the NVCS. This map class consists of two phases, the conifer (FBF) and conifer - hardwood (FFB). The Balsam Fir - Paper Birch Forest map class captures mesic to wet-mesic forests wherein the RD of conifers to hardwoods is >25% and the RD of balsam fir to other conifers (including northern white-cedar, eastern hemlock, and white pine) is >75%. White spruce can be present but should be sparse. The hardwood component is dominated by paper birch.

When the RD of sugar maple and yellow birch to paper birch (regardless of the density of balsam fir) was >25%, the Maple - Yellow Birch Northern Hardwoods Forest (FMB) map class was considered. When the RD of paper birch to other hardwoods was >90%, the forest was lacking conifer trees, and balsam fir was primarily of a sparse shrub-height, the Paper Birch / Fir Forest (FPB) map class was considered. Furthermore, when the RD of white cedar to balsam fir was >25%, the conifer - hardwood (FCM) phase of the White-cedar - Boreal Conifer Mesic Forest map class was considered.

The conifer (FBF) phase captures the balsam fir-paper birch forest wherein the RD of conifers (with balsam fir strongly dominant) to hardwoods is >75%. The conifer - hardwood (FFB) phase captures the forest wherein the mutual RD of conifers (again, with balsam fir strongly dominant) and hardwoods is >25%. The two map-class phases were often mapped in close proximity to each other.

For AA, the two map-class phases (FBF and FFB) were combined because they collectively represent one association type. They were left, however, as separate entities in the vegetation map layer.

Balsam Fir - Paper Birch Forest (conifer phase)–FBF

The conifer (FBF) map-class phase represents, in part, the Balsam Fir - Paper Birch Forest map class (as described above). In this phase, the RD of conifers to hardwoods is >75%, with a RD of balsam fir to all other conifers (including northern white-cedar, eastern hemlock, and white pine) of >75%. White spruce can be present but should be sparse. Hardwoods are often present to some degree and are often at the same canopy height as the conifers; however, when the RD of hardwoods to conifers was >25% and the RD of paper birch to all hardwoods was >75%, the hardwood-conifer (FFB) phase of this same map class was considered. It is also possible Spruce - Fir / Mountain Maple Forest (CEGL002446, not documented for APIS) in the NVCS may occur within the FBF phase when white spruce is in greater densities with the balsam fir.

The FBF phase is common to margins of beaver meadow complexes where beaver have removed hardwoods, leaving the balsam fir. Several instances of this scenario were mapped on the southern half of Outer Island. It is also common at locations having wind-thrown hardwoods caused by heavy winds from Lake Superior. In these scenarios, the canopy tends to be more clumped open.

On Devils Island, particularly the northern half, the floristics of wet-mesic sites may have components of sphagnum and ericads (e.g., Labrador-tea) common to peatland basins. When this floristic vegetation was coupled with a RD of black spruce to conifers of >25%, the black spruce (FSS) phase of the Black Spruce - Tamarack / Labrador-tea Poor Swamp map class was considered, even when not in an obvious peatland-basin site. Such scenarios seem to be unique to Devils Island and possibly North Twin Island, which are perhaps the most boreal-like locations of APIS.

Mapping of the FBF map-class phase was intermittent throughout APIS and was mapped infrequently on the mainland and in varying amounts on about half of the archipelago. For most islands, mapping of FBF was interior, along margins of beaver meadow complexes. Occasionally, FBF was mapped along landward margins to Lake Superior, although these scenarios were more frequently mapped as FFB. Most notable is that much of Devils Island (having the most boreal-like environment at the APIS) was mapped with FBF in concert with FFB–over three-fourths of Devils Island was mapped FBF and FFB combined.


Devils Island


Outer Island

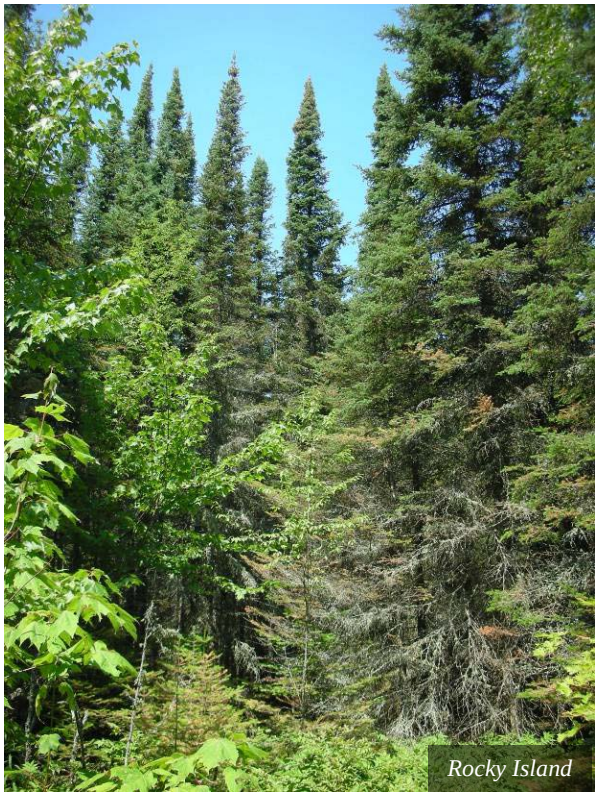

Devils Island



Outer Island



Outer Island



Rocky Island

Balsam Fir - Paper Birch Forest (conifer - hardwood phase)–FFB

The conifer - hardwood (FFB) map-class phase represents, in part, the Balsam Fir - Paper Birch Forest map class (as described above). In this phase, the RD of conifers (with balsam fir strongly dominant) to hardwoods is <75%, yet the mutual RD of conifers and hardwoods is >25%. The RD of balsam fir to all other conifers (including northern white-cedar, eastern hemlock, and white pine) is >75%. White spruce can be present but should be sparse. The RD of paper birch to other hardwoods is >75%; however, when the RD of conifers to hardwoods was >75%, with a RD of balsam fir to other conifers of >75%, the conifer (FBF) phase of this same map class was considered.

Often the paper birch canopy is above the balsam fir subcanopy, obscuring it from view. To determine the correct forest type, it was essential to refer to spring, leaf-off aerial photographs during the mapping of FFB to determine not merely the conifer component, but also the RD between conifer species (e.g., the RD of balsam fir to white-cedar). It is also possible that areas of Spruce - Fir - Aspen Forest (CEGL002475, not documented for APIS) may occur within the FFB map-class phase when balsam fir and white spruce make up >25% of the forest canopy.

Mapping of the FFB map-class phase was common throughout APIS, particularly from landward margins to Lake Superior, on both the mainland and all islands except Gull and Long. Perhaps over two-thirds of the mainland was mapped as FFB above the shoreline. Likewise, landward margins of most the northern islands of the archipelago were mapped as FFB, nearly encircling these islands and, thus, giving credence to the effect of wind on these islands. More interior to islands, some margins of beaver meadow complexes were mapped as FFB, although these scenarios were more frequently mapped as FBF. Noteworthy is that much of Devils Island (having the most boreal-like environment at the APIS) was mapped as FFB in concert with FBF–over three-fourths of Devils Island was mapped as FFB and FBF combined. The area of FFB mapped at the northern tip of the island was mapped with a shrub-height modifier, a reflection of the harsh wind environment of that location.


Rocky Island


Rocky Island



Devils Island (south end)



Devils Island (north end)

Paper Birch / Fir Forest (FPB)

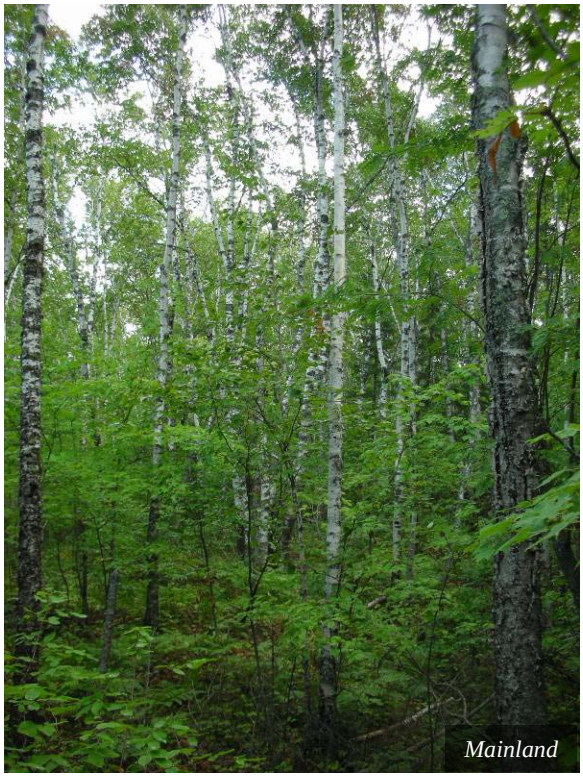
The Paper Birch / Fir Forest (FPB) map class represents the Betula papyrifera / *Diervilla lonicera* - (*Abies balsamea*) Forest Association (CEGL002463) in the NVCS. This map class captures nearly monotypic stands of paper birch in dry mesic to mesic forests wherein the RD of paper birch to other hardwoods is >90%. A sparse layer of balsam fir can be part of the shrub layer but is uncommon to the forest canopy. Typical locations of FPB are along the landward margins to Lake Superior.

When the RD of conifers (mostly of balsam fir) to paper birch was >10%, the conifer - hardwood (FFB) phase of the Balsam Fir - Paper Birch Forest map class was considered; however, when the RD of other hardwoods (such as sugar maple and yellow birch) to paper birch was >10%, even with dense balsam fir, the Maple - Yellow Birch Northern Hardwoods Forest (FMB) map class was considered. Likewise, when the RD of aspens and red maple to the paper birch (with other hardwoods nominally present) was >10%, the Aspen - Birch / Sugar Maple - Mixed Hardwoods Forest (FAM) or the Aspen - Birch / Boreal Conifer Forest (FAC) map classes were considered, depending on location (FAC only on the mainland) and the amount of conifer shrub present in the understory.

Mapping of the FPB map class was infrequent throughout APIS and was mapped occasionally on the mainland and about a third of the archipelago. Units of FFB were essentially mapped at landward margins to Lake Superior.

For AA, the FPB map class was assessed independently of all other map classes.


Outer Island


Mainland

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) of the NVCS. This map class captures mesic forests on the mainland only. FAC is often co-dominated by aspens and paper birch and has an obvious conifer understory made up of mostly balsam, with white spruce occasionally present. In this class, conifers are short-tree or shrub height. Red maple is often a common component, and a scattering of northern white-cedar may be present.

When the conifer understory made up <25% cover, the Aspen - Birch / Sugar Maple - Mixed Hardwoods Forest (FAM) map class was considered, which was mapped both on the mainland and on the islands; however, when the RD of other hardwoods (such as sugar maple and yellow birch) to aspens and paper birch was >25%, regardless of the amount of conifers present, the Maple - Yellow Birch Northern Hardwoods Forest (FMB) map class was considered. Furthermore, it is also possible Spruce - Fir - Aspen Forest (CEGL002475, not documented for APIS) may occur within the FAC map class when balsam fir and white spruce together make up >25% of the forest canopy.

Mapping of the FAC map class was infrequent throughout APIS and was only mapped on the mainland. Mapping of FAC was most frequent at the most western portion of the mainland in the Meyers Beech area. FAC was mapped occasionally on the remaining western half of the mainland and nominally on the eastern half.

For AA, the FAC map class was assessed independently of all other map classes.


Mainland

Black Spruce - Tamarack / Labrador-tea Poor Swamp (FSS and FTP)

The Black Spruce - Tamarack / Labrador-tea Poor Swamp map class represents the *Picea mariana* - (*Larix laricina*) / *Ledum groenlandicum* / *Sphagnum* spp. Forest Association (CEGL005271) in the NVCS. This map class consists of two phases, the black spruce (FSS) and tamarack (FTP). The Black Spruce - Tamarack / Labrador-tea Poor Swamp map class typically captures black spruce and/or tamarack in nutrient-poor peatland settings (receiving little minerotrophic waters from the adjacent landscape). Eastern white pine, hemlock, and northern white-cedar enter these poor swamps, particularly along the margins. Tree cover is >25%, including trees even as short as tall-shrub height. When tree cover was <25%, the Leatherleaf Poor Fen (DLF) map class was considered. Sphagnum and peatland ericads, including leatherleaf and Labrador-tea, dominate the ground flora, along with other vegetation common to peatlands, such as cranberry, blueberry, bog rosemary, pitcher plant, and thin-leaved sedges.

Most often, the Black Spruce - Tamarack / Labrador-tea Poor Swamp occurs within well-established peatland complexes, yet they can also occur on sandscapes, such as more interior zones of the tombolo on Stockton Island. There are occasions, however, where this poor swamp occurs on less developed peatland formations that have more wet-mesic characteristics, such as on the northern tip of Devils Island where boreal-like conditions are most evident at the APIS.

When the RD of black spruce and/or tamarack RD to other conifers was <25% and the RD of eastern hemlock to white-cedar was >50%, the Hemlock - Yellow Birch Swamp Wet-Mesic Forest (FHS) map class was considered. Likewise, when the RD of white-cedar to eastern hemlock was >50%, the White-cedar - (Mixed Conifer) / Alder Swamp (FCS) map class was considered.

Mapping of the Black Spruce - Tamarack / Labrador-tea Poor Swamp map class was intermittent throughout APIS–mapped locally to peatland complexes on both the mainland and a third of the archipelago. The Black Spruce - Tamarack / Labrador-tea Poor Swamp was mapped more commonly at Devils Island, Sand Island, and Stockton Island, and somewhat at Outer Island. The map class was mapped nominally on Bear Island, Michigan Island, and Otter Island, and only locally at Sand Bay on the mainland. Overall, the FSS phase was more commonly mapped (occurring on all islands identified above but Otter) than the FTP phase.

The black spruce (FSS) phase captures the poor swamp wherein the RD of black spruce to all other conifers is >25%. The tamarack (FTP) phase captures the poor swamp wherein the RD of tamarack to all other conifers is >75%. The two map-class phases were often mapped in close proximity to each other.

For AA, the two map-class phases (FSS and FTP) were combined because they collectively represent one association type. They were left, however, as separate entities in the vegetation map layer.

Black Spruce - Tamarack / Labrador-tea Poor Swamp (black spruce phase)–FSS

The black spruce (FSS) map-class phase represents, in part, the Black Spruce - Tamarack / Labrador-tea Poor Swamp map class (as described above). This phase captures poor swamp peatlands wherein the RD of black spruce to all other conifers (including tamarack, white pine, eastern hemlock, and northern white-cedar) is >25%. The FSS phase was mapped in close proximity to the tamarack (FTP) phase of this same poor swamp type. When the RD of tamarack to all other conifers was >75%, the FTP phase was considered.

Mapping of the FSS phase was mapped usually in concert with FTP and was mapped two to three times more than that of the FTP phase. FSS is usually the dominant phase of the poor swamp of an area.


Stockton Island


Stockton Island


Sand Island


Devils Island

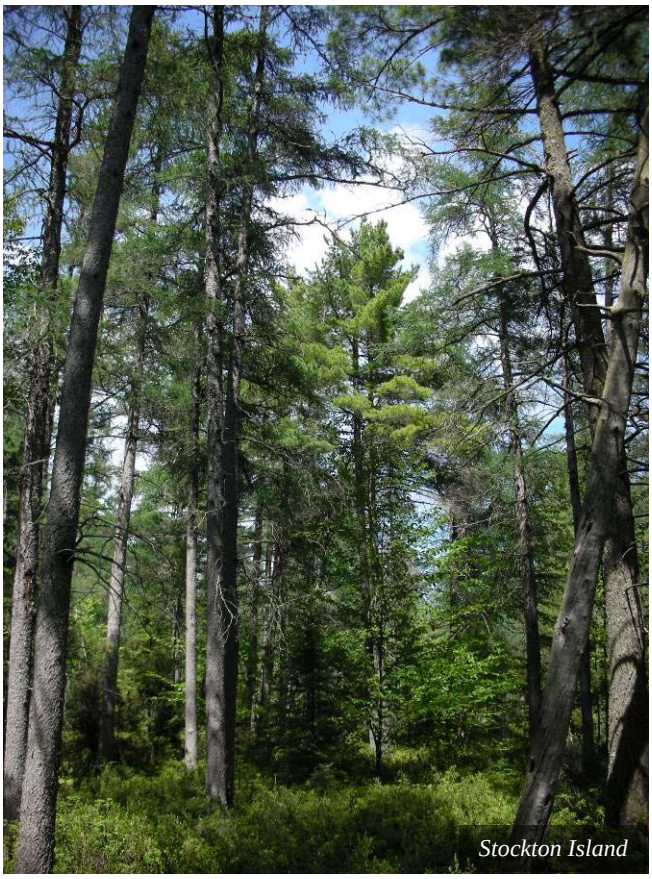
Black Spruce - Tamarack / Labrador-tea Poor Swamp (tamarack phase)–FTP

The tamarack (FTP) map-class phase represents, in part, the Black Spruce - Tamarack / Labrador-tea Poor Swamp map class (as described above). This phase captures poor swamp peatlands wherein the RD of tamarack to all other conifers (including black spruce, white pine, eastern hemlock, and northern white-cedar) is >75%. When gray alder shrub was present along with typical peatland flora of sphagnum and when ericads were depleted, the Northern Tamarack Rich Swamp (FTR) map class was considered, as these sites are more minerotrophic rich. The FTP phase was mapped in close proximity to the black spruce (FSS) phase of this same poor swamp type. When the RD of black spruce to all conifers was >25%, the FSS phase was considered.

Of all instances mapped with the Black Spruce - Tamarack / Labrador-tea Poor Swamp map class (FTP and/or FSS phases), mapping of the FTP phase was mapped usually in concert with FSS. The FTP phase was mapped two to three times less than that of the FSS phase. Rarely is FTP the dominant phase of the poor swamp of an area. Only one island (Otter) received mapping of FTP without any units of FSS mapped.


Sand Island


Stockton Island


Stockton Island

Northern Tamarack Rich Swamp (FTR)

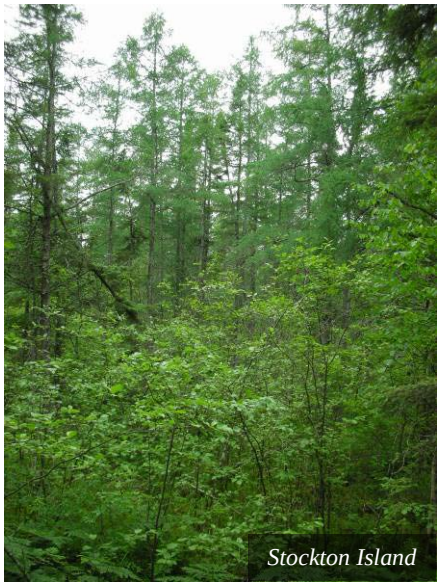
The Northern Tamarack Rich Swamp (FTR) map class represents the *Larix laricina* / *Alnus incana* Forest Association (CEGL002471) in the NVCS. This map class captures minerotrophic-rich swamp forests dominated by tamarack and having gray alder in the shrub understory. Sphagnum and peatland ericads are lacking or only nominally present. When alder was lacking and peatland flora was more developed, the tamarack (FTP) phase of the Black Spruce - Tamarack / Labrador-tea Poor Swamp map class was considered.

The RD of Black spruce to all other conifers is <25%, and the RD of tamarack to other trees (which may consist of northern white-cedar, red maple, black ash, yellow birch, and even some paper birch and eastern white pine) is >50%. When the RD of white-cedar to tamarack was >50%, the White-cedar - (Mixed Conifer) / Alder Swamp (FCS) map class was considered.

Mapping of the FTR map class was rare to APIS and was mapped in only three locations–a few units at Sand Bay on the mainland, one unit of the western end of Michigan Island, and a few units within the older portion of the tombolo on Stockton Island.

For AA, the FTR map class was assessed independently of all other map classes.


Stockton Island


Stockton Island

White-cedar - (Mixed Conifer) / Alder Swamp (FCS)

The White-cedar - (Mixed Conifer) / Alder Swamp (FCS) map class represents the *Thuja occidentalis* - (*Picea mariana*, *Abies balsamea*) / *Alnus incana* Forest Association (CEGL002456) in the NVCS. This map class captures conifer swamp forests wherein the RD of conifers to hardwoods is >75% and eastern white-cedar is the dominant conifer. The understory shrub is often of gray alder. Sphagnum and other peatland flora are common. Hardwoods, such as red maple, yellow birch, paper birch, and black ash, are sometimes present; however, when the RD of black ash and red maple hardwoods to conifers was >25%, the White-cedar - Black Ash Swamp (FCA) map class was considered.

FCS swamps can be open or have closed tree canopy. They are saturated wet, often part of peatland and beaver complexes, yet can easily grade into a wet-mesic version of White-cedar - Boreal Conifer Mesic Forest (two map-class phases–FCC and FCM, with FCC most probable). In FCS swamps, the RD of White-cedar to eastern hemlock and tamarack is >50%, and RD of black spruce to all conifers is <25%. When RD of hemlock to white-cedar was >50%, the Hemlock-Yellow Birch Swamp Wet-Mesic Forest (FHS) map class was considered. Likewise, when the RD of tamarack to white-cedar with an alder understory was >50%, the Northern Tamarack Rich Swamp (FTR) map class was considered. When the RD of black spruce and/or tamarack to all conifers was >25% RD and peatland flora was well established, the Black Spruce - Tamarack / Labrador-tea Poor Swamp map class (two phases, FSS and FTP) were considered.

Mapping of the FCS map class was infrequent throughout APIS. Only a few units were mapped on the mainland, mostly of the Sand Bay area. For islands, the most extensive mapping of FCS (yet still considered infrequent) was on Outer Island, mostly associated with beaver pond complexes. A few units of FCS were mapped on Stockton Island within the older portion of the tombolo, and a few more were mapped on the eastern end of Michigan Island, associated with beaver meadow complexes and peatland basins. FCS was mapped nominally on Sand Island.

For AA, the FCS map class was assessed independently of all other map classes.



Stockton Island

Deciduous Ruderal Shrubland (SDX)

The Deciduous Ruderal Shrubland (SDX) map class represents, in part, the Eastern Ruderal Shrubland & Grassland Group [Placeholder] (G059) in the NVCS. An association type could not be determined because disturbances from human activities (e.g., logging, homestead) and natural factors (e.g., wind-throw) lead to variability of floristic vegetation in these shrublands. Most occurrences of SDX are caused more by human activity than by natural factors. This map class captures ruderal upland shrublands wherein shrubs contribute >25% cover, and the RD of deciduous shrubs to conifer shrubs is >75%. Shrubs consist of any deciduous species common or unique to the APIS area. These shrublands can be open or have closed canopy, with trees contributing <25% cover.

When the RD of conifer shrubs to deciduous shrubs was >25%, the Conifer - Deciduous Ruderal Shrubland (SMX) map class was considered, which also represents, in part, the Eastern Ruderal Shrubland & Grassland Group [Placeholder] (G059) in the NVCS. Also, when trees made up >25% cover, either the Hardwood Ruderal Forest (FDX) map class or the Conifer - Hardwood Ruderal Forest (FMX) map class was considered, depending on the RD of conifers and hardwoods to each other. Furthermore, when shrubs contributed <25% cover, the Ruderal Grassland (HMX) map class was considered.

Mapping of the SDX map class was uncommon throughout APIS, mapped more on the mainland than on islands. The distribution of SDX is due to logging events occurring on the mainland in the 400-m buffer beyond the APIS boundary. On islands, SDX was mapped nominally on a third of the archipelago. A few SDX units were mapped in shrub fields cleared for lighthouses (Raspberry Island) or homesteads (whether active inholdings or abandoned) and also at a couple locations receiving natural disturbance, most notably the shrubland on Gull Island, which has a dynamic and harsh environment.

Because of the variability of vegetation inherent to ruderal shrublands, the SDX map class was not assessed for accuracy.


Basswood Island


Mainland



Devils Island



Outer Island

Conifer - Deciduous Ruderal Shrubland (SMX)

The Conifer - Deciduous Ruderal Shrubland (SMX) map class represents, in part, the Eastern Ruderal Shrubland & Grassland Group [Placeholder] (G059) in the NVCS. An association type could not be determined because disturbances from human activities (e.g., logging, homestead) and natural factors (e.g., wind-throw) lead to variability of floristic vegetation in these shrublands. Most occurrences of SMX are caused more by human activity than by natural factors. This map class captures ruderal upland shrublands wherein shrubs contribute >25% cover and the mutual RD of conifer and deciduous shrubs is >25%. Shrubs consist of any species common or unique to the APIS area. These shrublands can be open or have closed canopy, with trees contributing <25% cover.

When the RD of conifer shrubs to deciduous shrubs was <25%, 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. Also, when trees made up >25% cover, either the Hardwood Ruderal Forest (FDX) map class or the Conifer - Hardwood Ruderal Forest (FMX) map class was considered, depending on the RD of conifers and hardwoods to each other. Conversely, when shrubs contributed <25% cover, the Ruderal Grassland (HMX) map class was considered.

Mapping of the SMX map class was uncommon throughout APIS. A few SMX units were mapped on the mainland within the 400-m buffer beyond the APIS boundary. These are shrub fields resulting from logging events. On islands, a couple SMX units were mapped in shrub fields cleared for lighthouses (Devils Island and Sand Island) or homesteads (whether active inholdings or abandoned) and also at a couple locations receiving high winds that cause forest wind-throws (Eagle Island and York Island). The evergreen shrub component of these areas could likely be Canada yew.

Because of the variability of vegetation inherent to ruderal shrublands, the SMX map class was not assessed for accuracy.


Devils Island

Ruderal Grassland (HMX)

The Ruderal Grassland (HMX) map class represents, in part, the Eastern Ruderal Shrubland & Grassland Group [Placeholder] (G059) in the NVCS. An association type could not be determined because disturbances from human activities (e.g., logging, homestead) lead to variability of floristic vegetation in these shrublands. This map class captures ruderal upland herbaceous fields wherein shrubs and trees each contribute <25% cover. Herbaceous vegetation consists of various grasses and herbs common or unique to the APIS area; however, the emphasis is non-native vegetation.

When trees contributed >25% cover, either the Hardwood Ruderal Forest (FDX) map class or the Conifer-Hardwood Ruderal Forest (FMX) map class was considered, depending on the RD of conifers and hardwoods to each other. Likewise, when trees made up <25% cover yet shrubs contributed >25% cover, either the Deciduous Ruderal Shrubland (SDX) map class or the Conifer - Deciduous Ruderal Shrubland (SMX) map class was considered, depending on the RD of conifer and deciduous shrubs to each other. Like the HMX map class, the SDX and SMX map classes also represent, in part, the Eastern Ruderal Shrubland & Grassland Group [Placeholder] (G059) in the NVCS.

Mapping of the HMX map class was uncommon throughout APIS. A few HMX units were mapped on the mainland within the 400-m buffer beyond the APIS boundary. These herbaceous fields are of clearings used for pasture, hay, and logging activity. HMX was mapped nominally on just the four following islands: Basswood, Oak, Sand, and Stockton. Most of these areas were open fields that reflect some type of human occupation, whether associated with current inholdings or having been abandoned and remaining as fallow fields.

Because of the variability of vegetation inherent to ruderal herbaceous fields, the HMX map class was not assessed for accuracy.


Basswood Island

Great Lakes Beachgrass Dune (HAB)

The Great Lakes Beachgrass Dune (HAB) map class represents the *Ammophila breviligulata* - (*Schizachyrium scoparium*) Herbaceous Vegetation Association (CEGL005098) in the NVCS. This map class captures American beachgrass as the primary vegetation component on sandy shorelines, active sand dunes and foredunes, sandspits, and sand ridges, including the built-up sand ridges (stringers) between island lagoons and Lake Superior. The herbaceous cover can be low but usually contributes >10% of total cover. Other herbaceous components may consist of beach-pea, Canada wildrye, and scouringrush horsetail.

Total tree canopy is <10% cover, as environments of HAB restrict tree propagation because of the constant moving of sands by winds off of Lake Superior. When tree cover made up 10–60% cover, consisting of red pine, eastern white pine, and/or jack pine, the Great Lakes Coast Pine Barrens map class (two phases, HPB and HPW) was considered.

Within HAB, shrubs of woolly beach-heather, common juniper, bearberry, and sand cherry may persist, yet they should contribute <25% total cover. When shrubs were >25% cover, either the Great Lakes Beach-heather Dune Dwarf-shrubland (DBH) map class (when beach heather was dominant) or the Great Lakes Juniper Dune Shrubland (DJD) map class (when juniper was dominant) was considered. It is noteworthy, however, that these two types of shrubland were often mapped as inclusions to HAB because they were commonly found in areas less than the size of a MMU. Dynamic interdunal wetlands and non-vegetated sands were also found as inclusions within HAB. When vegetation cover was absent or nominal at best, the Sand & Cobble Beach (NSB) map class was considered (these are on the Lake Superior shores where vegetation is prevented to persist).

Beachgrass, and the density thereof, was difficult to discern on the aerial photographs because the sand dunes would overexpose the CIR imagery, diffusing even moderate density covers of herbaceous vegetation, as well as short-shrubs such as sand cherry. Subtle clues were vital to mapping HAB–even the faintest of vegetative appearance on the aerial photos proved to be a significant amount (>25% cover) of beachgrass. Thus, the mapping of HAB was aggressive in order to capture it.

Mapping of the HAB map class was intermittent throughout APIS–mapped commonly at sandy shorelines and sandspits on half of the archipelago, as well as along the shorelines of the mainland. Several HAB units were mapped on every island that has an established sandspit. HAB was also mapped on the mainland at both Sand Bay and Little Sand Bay. The most extensive mapping of HAB was on and throughout Long Island, consistent with the nature of this entire island being sandscape.

For AA, the HAB map class was assessed independently of all other map classes.


Outer Island


Stockton Island


Long Island


Long *Island*


Outer Island

Great Lakes Beach-heather Dune Dwarf-shrubland (DBH)

The Great Lakes Beach-heather Dune Dwarf-shrubland (DBH) map class represents the *Hudsonia tomentosa* Dune Dwarf-shrubland Association (CEGL004024) in the NVCS. This map class captures open dwarf-shrublands on active sand dunes and foredunes, with woolly beach-heather as the dominant shrub. American beachgrass, common juniper, bearberry, and sand cherry are often present. Dwarf-shrub cover is >25%, and the RD of beach-heather to all other shrubs (including juniper) is >50%. When the RD of juniper to all other shrubs was >50%, the Great Lakes Juniper Dune Shrubland (DJD) map class was considered; however, when dwarf-shrubs contributed <25% cover, the Great Lakes Beachgrass Dune (HAB) map class was considered.

Tree canopy contributes <10% cover because the environment limits tree propagation from moving sands and winds off of Lake Superior. When tree cover contributed 10–60% cover and consisted of red pine, eastern white pine, and/or jack pine, the Great Lakes Coast Pine Barrens map class (two phases, HPB and HPW) was considered.

Often, DBH was found in areas less than a MMU in size and was, thus, mapped as inclusions to HAB, DJD, HPB, and HPW, which are often in close proximity to each other.

Mapping of the DBH map class was rare to APIS, with one unit mapped on the far western end of Long Island and three units mapped on the active dunes along the eastern shores of the Stockton Island tombolo.

For AA, the DBH map class was assessed independently of all other map classes.



Stockton Island

Great Lakes Juniper Dune Shrubland (DJD)

The Great Lakes Juniper Dune Shrubland (DJD) map class represents the *Juniperus horizontalis - Arctostaphylos uva-ursi - Juniperus communis* Dune Dwarf-shrubland Association (CEGL005064) of the NVCS. This map class captures open short-shrublands on active sand dunes and foredunes with common juniper as the dominant shrub. American beachgrass, woolly beach-heather, bearberry, and sand cherry are often present. These shrublands are common between the beachgrass along the lake shorelines and the more established inland sandscapes. Shrub cover is >25%, with a RD of juniper to all shrubs (including beach-heather) of >50%. When the RD of beach-heather to all other shrubs was >50%, the Great Lakes Beach-heather Dune Dwarf-shrubland (DBH) map class was considered; however, when shrubs were <25% cover, the Great Lakes Beachgrass Dune (HAB) map class was considered.

Tree canopy is <10% cover because the environment limits tree propagation from moving sands and winds off of Lake Superior. When tree cover was 10–60% and consisted of red pine, eastern white pine, and/or jack pine, the Great Lakes Coast Pine Barrens map class (two phases, HPB and HPW) was considered.

Often, DJD is found in area smaller than a MMU was, thus, mapped as inclusions to HAB, DBH, HPB, and HPW, as well as Jack Pine/Blueberry/Feathermoss Forest (FJB) on Long Island, most of which are often in close proximity to each other.

Mapping of the DJD map class was rare to APIS and was mapped locally at sandscapes on the following four islands: the sandspits on Michigan and Outer, the tombolo on Stockton, and western half on Long.

For AA, the DJD map class was assessed independently of all other map classes.



Outer Island

Great Lakes Coast Pine Barrens (HPB and HPW)

The Great Lakes Coast Pine Barrens map class represents the *Pinus banksiana* - (*Pinus resinosa*) - *Pinus strobus* / *Juniperus horizontalis* Wooded Herbaceous Vegetation Association (CEGL005125) in the NVCS. This map class consists of two phases, barrens (HPB) and woodland (HPW). The Great Lakes Coast Pine Barrens map class captures red pine, eastern white pine, and/or jack pine forests that are on active sand dunes, foredunes, and sand ridges, including the built-up sand ridges (stringers) between island lagoons and Lake Superior. Tree canopy contributes 10–60% cover. When tree canopy was >60% cover on active sand dunes, the Great Lakes Dune Pine Forest (FPD) map class was most likely considered, unless one of the pine species dominated the forest, in which case other pine-forest map classes were considered.

The understory vegetation is of typical sandscape species, including American beachgrass, sand cherry, common juniper, bearberry, and woolly beach-heather. It is common to find small pockets (in areas smaller than a MMU) of Great Lakes Beachgrass Dune (HAB), Great Lakes Beach-heather Dune Dwarf-shrubland (DBH), and Great Lakes Juniper Dune Shrubland (DJD) within the Great Lakes Coast Pine Barrens. The RD of hardwoods to conifers is <25%.

When pine forests on sandscapes were more inland and not on active sand dunes, other pine-dominant map classes were considered, including White Pine / Blueberry Dry-Mesic Forest (FWP) and Jack Pine / Blueberry / Feathermoss Forest (FJB). These forests can have a somewhat open tree canopy.

Mapping of Great Lakes Coast Pine Barrens map class was somewhat rare to APIS, with both phases—HPB and HPW—mapped on the same three islands, with each island providing a slightly different sandscape environment. Areas of this class were mapped on the western half of Long Island (which in its entirety is a sandscape), both sides the double tombolo on Stockton Island, and the sandspit and lagoon margin of the southern tip on Outer Island. The HPW phase was mapped about three times as much as the HPB phase.

The barrens (HPB) phase captures the pine barrens wherein the tree canopy contributes 10–25% cover. The woodland (HPW) phase captures the pine barrens wherein the tree canopy contributes 25–60% cover.

For AA, the two map-class phases (HPB and HPW) were combined because they collectively represent one association type. They were left, however, as separate entities in the vegetation map layer.

Great Lakes Coast Pine Barrens (barrens phase)–HPB

The barrens (HPB) map-class phase represents, in part, the Great Lakes Coast Pine Barrens map class (as described above). In this phase, tree canopy contributes 10–25% cover. When canopy was 25–60% cover, the woodland (HPW) phase of this same map class was considered.



Stockton Island

Great Lakes Coast Pine Barrens (woodland phase)–HPW

The woodland (HPW) map-class phase represents, in part, the Great Lakes Coast Pine Barrens map class (as described above). In this phase, tree canopy contributes 25–60% cover. When canopy was 10–25% cover, the barrens (HPB) phase of this same map class was considered.



Stockton Island



Stockton Island



Outer Island

Alder - Willow Shore Fen (SAW)

The Alder - Willow Shore Fen (SAW) map class represents the *Alnus incana* - *Salix* spp. - *Betula pumila* / *Chamaedaphne calyculata* Shrubland Association (CEGL005227) of the NVCS. This is the one case where the map class was named differently than the official common association name found in the NVCS, which is Bog Birch - Willow Shore Fen. We chose to deviate from the name in the NVCS in this case because, at the APIS, gray alder is a primary shrub of this type, along with willows, but bog birch is not nearly as common.

The SAW map class captures seasonally saturated shore fen shrublands wherein tall-shrubs consisting primarily of alder and willows, with some dogwoods, contribute >25% cover. This minerotrophic-rich shrub shore fen is on sphagnum peat with common ericads present, including sweetgale, leatherleaf, bog rosemary, and Labrador-tea. Sedges and bluejoint are common herbaceous components. These shrub shore fens are typical to sandscape positions where the underlying water table of Lake Superior impacts the hydrology of the wetland. This is unlike Gray Alder Swamp Shrubland (SAS), which are common to saturated drainages and margins of peatland basins, which receive no hydrologic influence from Lake Superior. When the tall-shrubs of alder, willows, and dogwoods were less prominent and sweetgale and leatherleaf were more dominant, the Leatherleaf - Sweetgale Shore Fen (DLS) map class was considered.

Mapping of the SAW map class was uncommon throughout APIS, yet was mapped on several islands with sandspits, including Bear, Michigan, Outer, Raspberry, and Rocky. SAW was also mapped within sandy bays, including Sand Bay on the mainland and the north shore bay on York Island. On Stockton Island, SAW was mapped nominally, with one unit within the tombolo complex and another unit across the island on the north shore. The most extensive mapping of SAW was on the southern shores of Long Island. Nearly half of all SAW units were mapped on Long Island. Furthermore, on Long Island, small pockets of SAW located in areas smaller than a MMU exist and are left as inclusions within the Jack Pine - Aspen / Bush-honeysuckle Forest (FJM), which is a wet-mesic jack pine forest with mixed hardwoods known to exist at the APIS on the far western end of Long Island.

For AA, the SAW map class was assessed independently of all other map classes.


Outer Island


Mainland

Wiregrass Sedge Shore Fen (HSS)

The Wiregrass Sedge Shore Fen (HSS) map class represents the *Carex lasiocarpa* - (*Carex rostrata*) - *Equisetum fluviatile* Herbaceous Vegetation Association (CEGL005229) in the NVCS. This map class captures seasonally saturated sedge shore fens on sphagnum peat. These minerotrophic-rich herbaceous shore fens are typical to sandscape positions where the underlying water table of Lake Superior impacts the hydrology of the wetland. Woollyfruit sedge is the herbaceous component best characterizing HSS, especially when it is dominant, as one vegetation plot at Sand Bay on the mainland exhibits. Woollyfruit sedge can be, however, a minor component and even absent, as one site at the tombolo on Stockton Islands exhibits (at that site, coastal sedge and smooth sawgrass dominate the herbaceous layer).

Dwarf-shrubs, including leatherleaf, are typically present but contribute <25% cover. When shrubs contributed >25% cover and consisted primarily of sweetgale and/or leatherleaf, the Leatherleaf - Sweetgale Shore Fen (DLS) map class was considered. However, when dwarf-shrub ericads and sphagnum peat were absent and there was wetland substrate more of muck, the Northern Sedge Wet Meadow (HSG) map class was considered, particularly when more broad-leaved sedge species were thought to be present. The distinction between herbaceous types and dwarf-shrub types was not always an easy determination because ericad can be shorter than the herbaceous layer, even to the point of hindering ericad appearance on aerial photographs. In these cases, various cues were considered, including environmental position and water inundation. When extensive inundation occurred, the HSG map class was usually considered. From a mapping perspective, HSS and HSG can easily mosaic with each other.

Mapping of the HSS map class was rare to APIS–mapped nominally on the sandspits of Michigan Island and Raspberry Island and more extensively at the tombolo on Stockton Island. Vegetation plots were collected of HSS elsewhere, such as at Sand Bay on the mainland. These locations, however, were either determined to be smaller than a MMU, thus mapped as an inclusion within a DLS unit, or they were not easily distinguished from HSG.

For AA, the HSS map class was assessed independently of all other map classes.


Stockton Island


Raspberry Island

Leatherleaf - Sweetgale Shore Fen (DLS)

The Leatherleaf - Sweetgale Shore Fen (DLS) map class represents the *Chamaedaphne calyculata - Myrica gale* / *Carex lasiocarpa* Dwarf-shrubland Association (CEGL005228) in the NVCS. This map class captures seasonally saturated short-shrub shore fens on sphagnum peat. Short-shrubs contribute >25% cover, consisting primarily of sweetgale and/or leatherleaf. These minerotrophic-rich shore fens are typical to sandscape positions where the underlying water table of Lake Superior impacts the hydrology of the wetland. They also occur along streamsides and within beaver pond complexes receiving seasonal flooding. Other dwarf-shrub ericads may include some bog rosemary and cranberry. Tamarack, black spruce, and white pine may be scattered, with canopy contribution of <25% cover. Also, tall-shrubs including gray alder and willows may be present but should contribute <25% cover.

Within these shore fen environments, when tall-shrubs contributed >25% cover, the Alder - Willow Shore Fen (SAW) map class was considered. When all shrub strata each contributed <25% cover, the Wiregrass Sedge Shore Fen (HSS) map class was considered. The distinction between herbaceous types and dwarf-shrub types was not always an easy determination because ericads can be shorter than the herbaceous layer, even to the point of hindering the ericad appearance on aerial photographs. Furthermore, when short-shrubs were essentially all dwarf-shrub ericads—leatherleaf, Labrador-tea, bog-rosemary, cranberry, but not sweetgale—and in poor fen environments not receiving minerotrophic waters either indirectly from Lake Superior or directly from river or beaver pond flooding, the Leatherleaf Poor Fen (DLF) map class was considered.

Noteworthy is that units mapped as DLS received one of two possible height modifiers to the map class attribute. Normally, dwarf-shrub map classes receive a height modifier of <0.5 m; however, sometimes sweetgale dominates these short-shrub shore fens. Thus, in those units mapped as DLS wherein sweetgale was dominant over leatherleaf, the 0.5–5-m height modifier was assigned. Alternatively, when leatherleaf dominated over sweetgale, the <0.5-m height modifier was assigned.

Mapping of the DLS map class was somewhat infrequent and intermittent throughout APIS. On the mainland, DLS was mapped at Sand Bay, Little Sand Bay, and just west of Meyers Beach. A small floating mat of DLS within a beaver pond complex was mapped within the 400-m buffer beyond the APIS boundary. Mapping of DLS occurred on five islands, including the sandspits on Michigan, Outer, and Rocky; the double tombolo plus another small sandscape on Stockton; and the throughout the entire length of Long Island. The most extensive mapping of DLS is of Long Island and the Stockton Island tombolo. Also on Stockton Island, DLS was mapped in connection to a beaver pond complex.

For AA, the DLS map class was assessed independently of all other map classes.


Stockton Island


Long Island


Long Island


Long Island


Stockton Island


Stockton Island

Leatherleaf Poor Fen (DLF)

The Leatherleaf Poor Fen (DLF) map class represents the Chamaedaphne calyculata / *Carex oligosperma* / *Sphagnum* spp. Poor Fen Dwarf-shrubland Association (CEGL005277) in the NVCS. This map class captures poor fens within peatlands dominated by leatherleaf and other ericads, including Labrador-tea, cranberry, and bog-rosemary. These peatlands are within basins receiving low minerotrophic influence from surrounding water sources, either directly, as with seasonal flooding from beaver pond complexes or rivers, or indirectly, as with sandscapes of Lake Superior. When sites dominated with leatherleaf were near and influenced by water sources, the Leatherleaf - Sweetgale Shore Fen (DLS) map class was considered, in which sweetgale is a common associate to the leatherleaf.

Scattered black spruce, tamarack, and white pine are commonly present, even as short-tree or tall-shrub, but their canopy contribution should be <25% cover. When black spruce and/or tamarack contributed >25% cover over the ericad layer, the Black Spruce-Tamarack/Labrador-tea Poor Swamp map class (two phases, FSS and FTP) was considered.

Mapping of the DLF map class was somewhat rare and unique to APIS and was mapped on four islands, including Devils, Michigan, Outer, and Stockton.

For AA, the DLF map class was assessed independently of all other map classes.


Michigan Island


Stockton Island

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) of the NVCS. This map class captures wetland meadows with a diverse mix of emergent herbaceous vegetation—pioneering and persistent—receiving disturbance from dynamic hydrologic changes because of 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, they each have a RD to the mix of herbaceous vegetation of <25%. Woolgrass can be a common component of HWM. The soil substrate of HWM, similar to HCC and HSG, is of muck with little (if any) peat. Noteworthy is that herbaceous beaver meadows can be classified as HWM, HCC, or HSG, depending on beaver activity and subsequent vegetation response. Those beaver meadows having frequent or recent changes likely received the HWM map class during mapping.

Trees and shrubs are often present, each contributing <25% cover. When shrubs contributed >25% cover and consisted predominantly of gray alder, the Gray Alder Swamp Shrubland (SAS) map class was considered. When tree canopy made up >25% cover, with red maple, yellow birch, and paper birch most prominent, the Red Maple - Ash - Birch Swamp Forest (FRM) map class was considered.

Mapping of the HWM map class was somewhat uncommon and intermittent throughout APIS. A few units of HWM were mapped on the mainland within the 400-m buffer beyond the APIS boundary. Otherwise, mapping of HWM occurred on five islands, including Michigan (intermittently), Sand and South Twin (nominally), Stockton (intermittently), and Outer (most notably because of its plethora of beaver meadows).

For AA, the HWM map class was assessed independently of all other map classes.


Michigan Island


Outer Island

Bluejoint Wet Meadow (HCC)

The Bluejoint Wet Meadow (HCC) map class represents the *Calamagrostis canadensis - Eupatorium maculatum* Herbaceous Vegetation Association (CEGL005174) of the NVCS. This map class captures herbaceous wetland meadows dominated by bluejoint and are commonly receptive to beaver activity. Sedges are often present, but should have a RD to all herbaceous vegetation of <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 to sedges could not be determined from the aerial photographs, the HSG map class was typically the default assignment. When herbaceous vegetation consisted more of a diverse mix, with the RD of bluejoint and sedges to herbaceous vegetation each <25%, the Wet Meadow Mixed Herbaceous (HWM) map class was considered. The soil substrate of HCC, similar to HSG and HWM, is of muck with little peat, at the most.

Mapping of the HCC map class was rare to APIS–mapped nominally on five islands, including Long, Michigan, Outer, Sand, and Stockton.

For AA, the HCC map class was assessed independently of all other map classes.


Outer Island


Long Island

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). This map class captures emergent herbaceous wetland meadows wherein the RD of sedges to herbaceous vegetation (including bluejoint) is >25%. These sedge wetland meadows can occur on sandscapes and within bays in close proximity to shore fens or can occur more inland when associated with beaver meadows. When the 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 the density of herbaceous components present. When we were unable to determine the amount of bluejoint component to sedges by examining the aerial photographs, HSG was typically the default map class assigned.

The soil substrate of HSG, similar to that of HCC and HWM, is mostly muck; however, some peat build-up is common to HSG. When the substrate was more peat-based and less muck or when herbaceous wetland was located on sandscapes receiving minerotrophic water influence from Lake Superior—indirectly as it might be—the Wiregrass Sedge Shore Fen (HSS) map class was considered.

Mapping of the HSG map class was uncommon throughout APIS. Although nominal throughout the mainland, HSG was mapped a bit more extensively within Sand Bay. Mapping of HSG occurred with varying frequency on a third of the archipelago. Of all HSG that was mapped, it was mapped most commonly on Outer Island, in close association with beaver meadows.

For AA, the HSG map class was assessed independently of all other map classes.


Long Island


Long Island

Clay Seeps (N/A)

Because areas of clay seeps are too small to map (well below the size of a MMU), no map class was derived for this vegetation type, which is the Clay Seeps Sparse Vegetation Association (CEGL005163) in the NVCS; therefore, other map classes capture the Clay Seeps type as an inclusion. It is thought that this vegetation type was mapped most frequently as an inclusion within the Eroding Clay Bank (VEB) map class, which represents the Eroding Clay Bank Sparse Vegetation Association (CEGL002584) in the NVCS. Clay seeps are diminutive seeps on slope, often of the toeslope. They are commonly seen on the edges of islands where the clay banks are exposed, thus within VEB.

Because of the lack of a map class for this vegetation type, the Clay Seeps type was not assessed for accuracy.



Michigan Island

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 (mostly of watershield, but also American white waterlily and yellow pond-lily) that contributes >10% cover and emergent vegetation that contributes <10% cover. Submergent vegetation, including pondweeds, coon's-tail, bladderwort, and floating bur-reed, may be of high density. Although rare to APIS as a whole, HFA is customary to the few deeper beaver ponds found landward on some islands and the mainland, as well as to deeper lagoons and interdunal swales of some sandscapes (again of islands and the mainland).

Much of the floating aquatic and submergent vegetation had senesced before aerial photography was collected in October; thus, observable appearances on the aerial photographs were minimal. Sites of HFA were mapped when floating aquatic vegetation was observable on the fall aerial photographs. Based on field experience, it is expected that more HFA covering areas larger than the size of a MMU existed at the time photography was acquired than what could actually be observed on the photographs. It is most likely that these unveiled areas of HFA are captured with the Midwest Pondweed Submerged Aquatic Wetland (HSV) map class, because HSV shares the same deep water marsh environment. Readers should refer to the HSV map class description to understand the aggressive approach we took in mapping HSV and how HFA might be further represented.

Mapping of the HFA map class was somewhat rare and intermittent throughout APIS. HFA was mapped on the mainland and three islands, including Michigan, Outer, and Stockton. All those areas mapped on Stockton Island were on the eastern half of the double tombolo, within the large sandscape lagoon. This is perhaps the most extensive mapping of HFA at the APIS. More HFA was mapped within sandscape lagoons on Michigan Island and on the mainland at Little Sand Bay. A few units of HFA were mapped within deeper beaver ponds on the mainland above Sand Bay, within the 400-m buffer beyond the APIS boundary, and on Michigan Island and Outer Island (all mapped in the interior of those islands).

For AA, the HFA and HSV map classes were assessed together because of the senesced vegetation of both classes, which are found within the same setting of deep marsh environments. HFA and HSV are left, however, as separate map classes in the vegetation map layer. When using the vegetation map layer, one should not assume the reported accuracy pertains to each map class independently, but rather collectively. This is the only case where two map classes that are assigned to separate vegetation types were assessed together. Other instances where phases are assessed together are actually within a particular map class.



Stockton Island



Michigan Island

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 vegetation, including pondweeds, coon's-tail, bladderwort and floating bur-reed, contributes >10% cover. In addition, herbaceous emergent vegetation and floating-leaved aquatic vegetation each contribute <10% cover. Although rare to APIS as a whole, HSV is most common to deep beaver ponds found landward on three islands and the mainland.

Much of the submergent and floating aquatic vegetation had senesced before aerial photography was collected in October; thus, observable appearances on the aerial photographs were minimal. Sites of HSV were mapped when submergent vegetation was observable on the fall aerial photographs. Based on field experience, it is expected that more HSV was present in areas larger than a MMU at the time photography was obtained than what could actually be observed on the photographs. Thus, the approach in mapping most ponds was to assign the HSV map class even when appearance of submergent vegetation was lacking. This was an aggressive effort to map HSV based on likely locations. Again, this decision was based on field experience where most ponds were observed to have submergent vegetation. When the HSV map class was assigned to ponds appearing as open water on the aerial photographs, the physiognomic modifier of 10–25% cover density was applied to the map-class attribute.

When open water bodies smaller than 8 ha in area were determined to be too deep for submergent and floating aquatic vegetation to grow, the Open Water Pond (NWP) map class was considered. In areas larger than 8 ha, the Open Water Lake (NWL) map class was considered. The NWP and NWL map classes are not included in the NVCS.

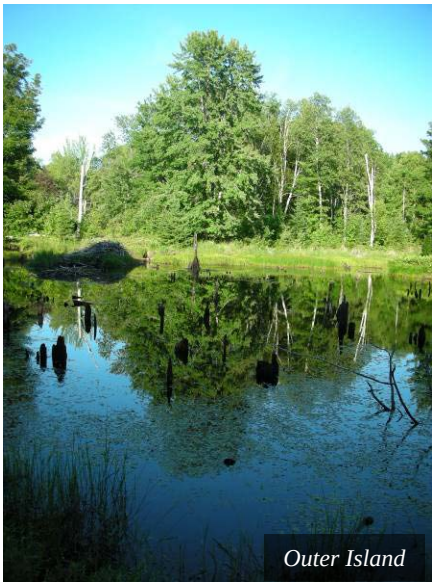
Because floating aquatic vegetation was also senesced at the time photography was obtained, it is anticipated that some Northern Water-lily Aquatic Wetland (HFA) areas were captured within the HSV map class, because HFA shares the same deep water marsh environment.

Mapping of the HSV map class was rare and intermittent throughout APIS. HSV was mapped on the mainland and three islands, including Outer, Sand, and Stockton (with Outer mapped most commonly with HSV). On the mainland, HSV was mapped within Sand Bay, where the Sand River enters Lake Superior. One other unit of HSV was mapped on the mainland at a beaver pond, located within the 400-m buffer beyond the APIS boundary.

For AA, the HSV and HFA map classes were assessed together because of the senesced vegetation of both, which are found within the same type of deep marsh environments. These classes are left, however, as separate map class entities in the vegetation map layer. When using the vegetation map layer, one should not assume the reported accuracy pertains to each map class independently, but rather collectively. This is the only case where two map classes that are assigned to separate vegetation types were assessed together. In other instances where phases were assessed together, the vegetation types were actually within the same map class.



Outer Island



Outer Island

Eroding Clay Bank (VEB)

The Eroding Clay Bank (VEB) map class represents the Eroding Clay Bank Sparse Vegetation Association (CEGL002584) in the NVCS. This map class captures exposed eroding clay embankments along margins of islands above the Lake Superior shoreline. Vegetation, which consists of herbaceous vegetation, shrubs, and trees, fluctuates in terms of contribution to total cover. Although VEB cover tends to increase to >10%, it is in a constant cycle of erosion; therefore, VEB usually contributes <10% cover. Vegetation consists of herbaceous clumps with a sparse scattering of shrubs and trees. Trees often consist of northern white-cedar, balsam fir, red maple, and paper birch. When contribution of tree canopy is >25% cover, signifying a more stable soil condition, the appropriate forest map class was considered.

Commonly found within VEB areas are Clay Seeps, which is the Clay Seeps Sparse Vegetation Association (CEGL005163) in the NVCS. No map class was derived for Clay Seeps because areas are much too small to map (well below the size of a MMU); however, most Clay Seeps are mapped within the VEB map class.

Mapping of the VEB map class was intermittent throughout APIS, common to only a few locations. VEB was mapped on almost half of the archipelago, with most islands having a nominal presence; however, VEB was mapped more prevalently on two islands, including Michigan and Outer. Much of the northwestern margin of Outer Island is mapped as VEB, and barring the sandspit, over three-fourths the perimeter of Michigan Island was mapped as VEB. Only a single unit of VEB was mapped on the mainland shores.

For AA, the VEB map class was assessed independently of all other map classes.


Raspberry Island


Michigan Island

Great Lakes Sandstone Bedrock Shore (VBS)

The Great Lakes Sandstone Bedrock Shore (VBS) map class represents the Sandstone Bedrock Great Lakes Shore Sparse Vegetation Association (CEGL002507) in the NVCS. This map class captures sandstone bedrock ledges along the shores of Lake Superior. These flat ledges are near level in elevation to Lake Superior (usually within 3 m), thus receive direct lake moisture from wave action and the splashing thereof. Although with sparse vegetation that contributes <10% cover, these bedrock shores are home to a variety of plants, mostly herbaceous, but also of dwarf-shrubs, mosses, and lichens. These plants take hold in small cracks and crevices within the sandstone bedrock ledges.

Because most VBS areas are small, the standard MMU of 0.5 ha was reduced to 0.25 ha. Even at this reduced MMU size, however, several small VBS units remain as inclusions to neighboring vegetation types (often forests) further inland. Furthermore, inclusions of the Great Lakes Shore Sandstone Cliff (VSC), which are sandstone cliff ledges elevated >3 m directly above the shores of Lake Superior, are common within VBS. (An MMU of 0.25 ha was applied to VSC as well.) Likewise, when VSC was mapped, often inherent were inclusions of VBS. In addition, there were occasions when VBS and VSC met the MMU criteria only when they were combined, in which cases they were mapped together and the unit assigned was the map class best representing the majority of the area. The idea here was to map as much VBS and VSC within the sparse vegetation map classes as possible, even if it meant combining the two in order to reach an MMU. Otherwise, these two classes would be lost as inclusions within various map-class units landward.

Mapping of the VBS map class was somewhat rare to APIS–mapped on only a half dozen islands. VBS was mapped nominally on Bear, Devils, Sand, and Stockton and more prevalently on the eastern shores of both North Twin and Outer. No VBS was mapped on the mainland shores.

For AA, the VBS map class was assessed independently of all other map classes.



Devils Island

Great Lakes Shore Sandstone Cliff (VSC)

The Great Lakes Shore Sandstone Cliff (VSC) map class represents the Sandstone Great Lakes Shore Cliff Sparse Vegetation Association (CEGL002503) in the NVCS. This map class captures sandstone bedrock cliff ledges directly above the shores of Lake Superior. Ledges are elevated >3 m above the lake and thus receive little direct lake moisture. Although with sparse vegetation that contributes <10% cover, these bedrock cliffs are home to a variety of plants that are mostly herbaceous but that also includes dwarf-shrubs, mosses, and lichens. These plants take hold in small cracks and crevices within the sandstone bedrock ledges.

Because most VSC areas are small, the standard MMU of 0.5 ha was reduced to 0.25 ha. Even at this reduced MMU size, however, several small VSC remain as inclusions within neighboring vegetation types (often of forests) further inland. Furthermore, inclusions of the Great Lakes Sandstone Bedrock Shore (VBS), which are sandstone ledges nearer the elevation of Lake Superior, are common within VSC. (An MMU of 0.25 ha was applied to VBS as well.) Likewise, when VBS was mapped, often inherent were inclusions of VSC. In addition, there were occasions when VSC and VBS met the MMU criteria only when they were combined, in which cases they were mapped together and the unit assigned was the map class best representing the majority of the area. The idea here was to map as much of VSC and VBS within the sparse vegetation map classes as possible, even if it meant combining the two in order to reach an MMU. Otherwise, these types would be lost as inclusions within various map-class units landward.

Mapping of the VSC map class was rare to APIS–mapped only on four islands. VSC was mapped nominally on Bear and York and more prevalently on the northeastern and eastern shores of Stockton and the eastern and western shores of Devils. No VSC was mapped on the mainland shores.

For AA, the VSC map class was assessed independently of all other map classes.


Devils Island

Developed Area (NDV)

The Developed Area (NDV) map class falls under the Developed Vegetation Cultural Class (8) of the NVCS and is defined in the NVCS to Level 3, Other Developed Urban / Built Up Vegetation Formation. From there, finer break outs are defined with the use of modifiers to depict varying amounts of impervious surface in developed areas. These modifiers represent classes 21–24 in the National Land Cover Database (NLCD) 2001. The NDV map class captures areas having regular human use. Examples at the APIS include roads and their right-of-ways, homesteads and farmsteads, campgrounds, picnic areas, boat launches, and various APIS grounds, such as lighthouses, ranger stations, visitor centers, and building structures.

Mapping of the NDV map class was mostly nominal on islands and common on the mainland. NDV mapping on the mainland consisted mostly of roads. Mapping of NDV occurred on about half of the archipelago, with many islands having only one unit mapped, often the lighthouse and grounds. Of the islands, Sand Island received the most mapping of NDV (infrequent as it still remains), with several private inholdings scattered along portions of the island's shores.

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 High Intensity (24) class was not used for the mapping of APIS, yet remains included here for completeness and comparison purposes. Definitions are taken from the NLCD.

Open Space–21 (O)

This class includes areas consisting mostly of vegetation in the form of lawn grasses but that also have a mixture of some constructed materials. 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.



Mainland–near Little Sand Bay

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.



Raspberry Island–Lighthouse Grounds

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.



Mainland–Little Sand Bay Visitor Center


Mainland–Little Sand Bay Recreation Area


Mainland–Park Road

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 Open Water (11) class in the NLCD 2001. This map class captures open water streams and rivers. Sparse aquatic, submergent vegetation may be present (usually in shallower waters close to shorelines), but vegetation contributes <10% cover. When submergent vegetation contributed >10% cover, the Midwest Pondweed Submerged Aquatic Wetland (HSV) map class was considered.

Mapping of the NSR map class was rare to APIS–mapped only on the mainland, including two small units near Meyers Beach and another unit of the Sand River above the Sand Bay complex. The two units mapped near Meyers Beach are of two separate, small streams. These streams are of mappable width only as they meet the shores of Lake Superior, where they are semi-impounded by built-up sand along the lake's shoreline. The one unit mapped of the Sand River is within the 400-m buffer beyond the APIS boundary. As it nears the Sand Bay wetland complex, the river becomes too narrow to map as it diffuses into the surroundings.

Because NSR is a non-vegetation map class, it was not assessed for accuracy.



Mainland – Saxine Creek

Open Water Pond (NWP)

The Open Water Pond (NWP) map class represents, in part, the Open Water (11) class in the NLCD 2001. This map class captures open water bodies that are <8 ha in area. When >8 ha, the Open Water Lake (NWL) map class was considered, which also represents, in part, the Open Water (11) class in the NLCD. These ponds are usually deep enough that vegetation is unable to take root. Wetland vegetation (emergent and/or aquatic) may be present, usually in shallower waters close to shorelines, but contributes <10% cover.

Usually, shallow ponds within beaver meadows and sandscape lagoons provide an environment for wetland vegetation and some aquatic vegetation to thrive. With aerial photography collected in October, much of the aquatic vegetation had senesced. In many instances, observable occurrences of aquatic vegetation were lacking on the aerial photographs. This posed a problem for mapping Midwest Pondweed Submerged Aquatic Wetland (HSV) and Northern Water-lily Aquatic Wetland (HFA). Based on field experience, most shallow ponds appearing as open water on the aerial photographs were found with aquatic vegetation. Thus, the approach in mapping most shallow ponds appearing as open water on the aerial photographs was to assign the HSV map class. This was an aggressive effort to map aquatic vegetation based on likely locations.

One pond within the lagoon of the tombolo on Stockton Island provided an exception to the above convention. From field observation, it was determined that submergent vegetation was not present, as this open water body was too deep for vegetation to take root; therefore, this pond was classified as NWP.

Mapping of the NWP map class was rare to APIS–mapped only of the one small pond within the lagoon of the tombolo on Stockton Island.

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 Open Water (11) class in the NLCD 2001. This map class captures open water bodies that are >8 ha in area and have <10% vegetation present. When areas were <8 ha in size, the Open Water Pond (NWP) map class was considered, which also represents, in part, the Open Water (11) class in the NLCD. The NWL captures the Lake Superior waters along the mainland and surrounding every island of the archipelago. One other location thought to meet NWL criteria is the larger, shallow water body within the Outer Island sandscape lagoon. Usually, shallow ponds—particularly those of beaver meadows, but also within sandscape settings, too—provide an environment for wetland vegetation and some aquatic, submergent vegetation to thrive.

With aerial photography collected in October, much of the submergent and floating-leaved aquatic vegetation had senesced. In many instances, observable occurrences of aquatic vegetation were lacking on the aerial photographs. This posed a problem for mapping Midwest Pondweed Submerged Aquatic Wetland (HSV) and Northern Water-lily Aquatic Wetland (HFA). Based on field experience, most shallow ponds appearing as open water on the aerial photographs were found with aquatic vegetation. Thus, the approach in mapping most shallow ponds appearing as open water on the aerial photographs was assigned to the HSV map class. This was an aggressive effort to map aquatic vegetation based on likely locations.

The Outer Island sandscape lagoon is the exception to the above convention. From field observation, it was determined that submergent vegetation was not evident in this large, open body of water within a sandscape setting.

Mapping of the NWL map class was common throughout APIS–mapped around every island and the mainland. Only one unit of NWL was mapped interior to an island, the sandspit lagoon on Outer Island.

Because NWL is a non-vegetation map class, it was not assessed for accuracy.



Stockton Island–Presque Isle Bay

Sand & Cobble Beach (NSB)

The Sand & Cobble Beach (NSB) map class represents the Barren Land (31) class in the NLCD 2001. This map class captures sand, cobble, and rock-boulder shorelines of Lake Superior that largely lack vegetation. These locations have persistent and direct impacts from Lake Superior such that vegetation types cannot establish. When vegetation was present, particularly on sandy beaches with American beachgrass as the primary vegetation, the Great Lakes Beachgrass Dune (HAB) map class was considered.

Mapping of the NSB map class was intermittent throughout APIS–mapped commonly at sandy shorelines and sandspits on two-thirds of the archipelago, as well as the shorelines of the mainland. NSB was mapped nominally on many of the islands, whereas it was mapped more extensively on others. The northern perimeter of Long Island and the eastern perimeter of Rocky Island were almost completely mapped as NSB. Sandscapes, large or small, were typically mapped as NSB along their shores–most notably, the double tombolo of Stockton Island and the sandspits of Michigan Island and Outer Island. About a third of the shoreline (the longest stretch of the Meyers Beach area) of the mainland was mapped as NSB.

Because NSB is a non-vegetation map class, it was not assessed for accuracy.



Michigan Island–near lagoon



Rocky Island–western shoreline



Stockton Island–Tombolo (Julian Bay)



Mainland–Sand Bay



Stockton Island–Tombolo (Julian Bay)

Table E-2. Map classification listing, sorted alphabetically by map-class code, used for the Apostle Islands National Lakeshore vegetation mapping project.

Map-class Code	Map-class Name
DBH	Great Lakes Beach-heather Dune Dwarf-shrubland
DJD	Great Lakes Juniper Dune Shrubland
DLF	Leatherleaf Poor Fen
DLS	Leatherleaf - Sweetgale Shore Fen
FAC	Aspen - Birch / Boreal Conifer Forest
FAM	Aspen - Birch / Sugar Maple - Mixed Hardwoods Forest
FBA	Black Ash - Mixed Hardwood Swamp
FBF	Balsam Fir - Paper Birch Forest (conifer phase)
FBR	Aspen - Birch - Red Maple Forest
FBS	Black Spruce / Feathermoss Forest
FCA	White-cedar - Black Ash Swamp
FCC	White-cedar - Boreal Conifer Mesic Forest (conifer phase)
FCM	White-cedar - Boreal Conifer Mesic Forest (conifer - hardwood phase)
FCS	White-cedar - (Mixed Conifer) / Alder Swamp
FDX	Hardwood Ruderal Forest
FFB	Balsam Fir - Paper Birch Forest (conifer - hardwood phase)
FHC	Hemlock Mesic Forest
FHM	North-Central Hemlock - Hardwood Forest
FHS	Hemlock - Yellow Birch Swamp Wet-Mesic Forest
FJB	Jack Pine / Blueberry / Feathermoss Forest
FJM	Jack Pine - Aspen / Bush-honeysuckle Forest
FJO	Jack Pine - Northern Pin Oak Forest
FMB	Maple - Yellow Birch Northern Hardwoods Forest
FMT	Northern Maple - Basswood Forest
FMX	Conifer - Hardwood Ruderal Forest
FOM	Northern Red Oak - Sugar Maple Forest
FPB	Paper Birch / Fir Forest
FPD	Great Lakes Dune Pine Forest
FPE	Conifer Plantation
FPO	Northern Pin Oak - (Bur Oak) Forest
FRA	Red Pine - Aspen - Birch Forest
FRM	Red Maple - Ash - Birch Swamp Forest
FRP	Red Pine / Blueberry Dry Forest
FSS	Black Spruce - Tamarack / Labrador-tea Poor Swamp (black spruce phase)
FTP	Black Spruce - Tamarack / Labrador-tea Poor Swamp (tamarack phase)
FTR	Northern Tamarack Rich Swamp
FWA	White Pine - Aspen - Birch Forest
FWH	Great Lakes White Pine - Hemlock Forest
FWM	White Pine / Mountain Maple Mesic Forest
FWP	White Pine / Blueberry Dry-Mesic Forest

Map-class Code	Map-class Name
FYB	Yellow Birch - (White Spruce) Forest
HAB	Great Lakes Beachgrass Dune
HCC	Bluejoint Wet Meadow
HFA	Northern Water-lily Aquatic Wetland
HMX	Ruderal Grassland
HPB	Great Lakes Coast Pine Barrens (barrens phase)
HPW	Great Lakes Coast Pine Barrens (woodland phase)
HSG	Northern Sedge Wet Meadow
HSS	Wiregrass Sedge Shore Fen
HSV	Midwest Pondweed Submerged Aquatic Wetland
HWM	Wet Meadow Mixed Herbaceous
NDV	Developed Area
NSB	Sand & Cobble Beach
NSR	Stream & River
NWL	Open Water Lake
NWP	Open Water Pond
SAS	Gray Alder Swamp Shrubland
SAW	Alder - Willow Shore Fen
SDX	Deciduous Ruderal Shrubland
SMX	Conifer - Deciduous Ruderal Shrubland
VBS	Great Lakes Sandstone Bedrock Shore
VEB	Eroding Clay Bank
VSC	Great Lakes Shore Sandstone Cliff

Appendix F: Accuracy Assessment Form

NATIONAL PARK VEGETATION MAPPING PROGRAM: ACCURACY ASSESSMENT POINT FORM

IDENTIFIERS/LOCATORS

Field Point Code _____ Database Point Code _____

State _____ Park Name _____ Park Site Name _____

Quad Name _____ Quad Code _____

Primary Veg Assoc Name _____

Secondary Veg Assoc Name _____

Other Veg Assoc within 50 m _____

Classification Comments:

GPS file name _____ Field UTM X ___ ___ ___ ___ ___ ___ m E Field UTM Y ___ ___ ___ ___ ___ ___ ___ m N

GPS Error _____ m

please do not complete the following information when in the field

Corrected UTM X ___ ___ ___ ___ ___ ___ m E Corrected UTM Y ___ ___ ___ ___ ___ ___ ___ m N UTM Zone_____

Survey Date _____ Surveyors _____

ENVIRONMENTAL DESCRIPTION

Elevation _____ Slope _____ Aspect _____

Topographic Position

Landform

Environmental Comments (including hydrology):

Unvegetated Surface: *(please use the cover scale below)*
___Bedrock
___Litter, duff
___Wood (> 1 cm)
___Large rocks (cobbles, boulders > 10 cm)
___Small rocks (gravel, 0.2-10 cm)
___Sand (0.1-2 mm)
___Bare soil
___Other: _____

VEGETATION DESCRIPTION

Leaf phenology
(of dominant stratum)
Trees and Shrubs
___Evergreen
___Cold-deciduous
___Drought-deciduous
___Mixed evergreen - cold-deciduous
___Mixed evergreen - drought-deciduous

Herbs
___Annual
___Perennial

Leaf Type
(of dominant stratum)
___Broad-leaved
___Needle-leaved
___Mixed broad-leaved/Needle leaved
___Microphyllous
___Graminoid
___Forb
___Pteridophyte

Physiognomic class

___Forest
___Woodland
___Shrubland
___Dwarf Shrubland
___Herbaceous
___Nonvascular
___Sparsely Vegetated

Cover Scale for Unvegetated Surface

01	5%
02	10%
03	20%
04	30%
05	40%
06	50%
07	60%
08	70%
09	80%
10	90%
11	100%

Strata	Height	Cover Class	Dominant species (mark any known diagnostic species with a *)	Cover Class
T1 Emergent	_____	_____	_____	
T2 Canopy	_____	_____	_____	
T3 Sub-canopy	_____	_____	_____	
S1 Tall shrub	_____	_____	_____	
S2 Short Shrub	_____	_____	_____	
S3 Dwarf-shrub	_____	_____	_____	
H Herbaceous	_____	_____	_____	
N Non-vascular	_____	_____	_____	
V Vine/liana	_____	_____	_____	
E Epiphyte	_____	_____	_____	

Comments

Cover Scale: Strata and Species	
01	5%
02	10%
03	20%
04	30%
05	40%
06	50%
07	60%
08	70%
09	80%
10	90%
11	100%

Height Scale: Strata	
0	<0.5 m
02	0.5-1 m
03	1-2 m
04	2-5 m
05	5-10 m
06	10-15 m
07	15-20 m
08	20-35 m
09	35-50 m
10	>50 m

Appendix G: Accuracy Assessment Contingency Table

Explanation of the Contingency Matrix

The accuracy assessment contingency matrix for the Apostle Islands National Lakeshore 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.

The following contingency matrix is formatted to a tabloid-size page (11" x 17") in landscape orientation.

MAP DATA - PREDICTION DATA: MAP CODES	FIELD SAMPLES - REFERENCE DATA: FPD	FJB	FRP	FWH	FWP	FWM	FCC, FCM	FBS	FFB, FBF	FSS, FTP	FCS	FHS	FMB	FYB	FMT	FPO	FOM	FPB	FBR	FAC	FAM	FBA	FRM	FTR	FJM	FJO	FRA	FWA	FHC	FHM	FCA	SAS	SAW	DBH	DJD	DLS	DLF	HAB	HWM	HCC	HSG	HSS	HPB, HPW	HSV, HFA	VSC	VBS	VEB	COMISSION: TOTAL	USERS' ACCUR-ACY	90% Confidence Intervals	
FPD	5																																														5	100%	90%	110%
FJB		4																																														5	80%	41%	119%
FRP			5																																													5	100%	90%	110%
FWH				5																																												5	100%	90%	110%
FWP			1		3																																											4	75%	27%	123%
FWM						2																																											2	100%	75%	125%
FCC, FCM							49		2		1		1															1	4																		58	84%	76%	93%
FBS								5																																								5	100%	90%	110%
FFB, FBF							1	1	23				1							2								1																				29	79%	65%	93%
FSS, FTP										28	1												1								2																30	93%	84%	102%
FCS											3																																					5	60%	14%	106%
FHS										1	1	3																																			5	60%	14%	106%
FMB													43					1			1								2																		47	91%	84%	99%
FYB														1																																		1	100%	50%	150%
FMT															1																																	1	100%	50%	150%
FPO																2																																2	100%	75%	125%
FOM													4				22				1																										27	81%	67%	96%
FPB													1					1			2																											4	25%	-23%	73%
FBR																			5																													5	100%	90%	110%
FAC																				20																													20	100%	98%	103%
FAM																	2				27																												29	93%	84%	103%
FBA																		1		3		19	1																									24	79%	63%	95%
FRM											2	1											24																									27	89%	77%	101%
FTR																								5																									5	100%	90%	110%
FJM																									3																								3	100%	83%	117%
FJO																										4																							4	100%	88%	113%
FRA																											4																						4	100%	88%	113%
FWA				1			1		2					1														15	3	5																		28	54%	36%	71%
FHC							1																						15																			16	94%	81%	107%
FHM																														31																			31	100%	98%	102%
FCA				1																	1										3																	5	60%	14%	106%
SAS																					1											27	1								1						30	90%	79%	101%
SAW											1																					20																21	95%	85%	105%
DBH																																	4															4	100%	88%	113%
DJD																																		5														5	100%	90%	110%
DLS																																1	4		23	1								1				30	77%	62%	91%
DLF																																				7												7	100%	93%	107%
HAB																																					30											30	100%	98%	102%
HWM																																						29	2									31	94%	85%	102%
HCC																																							4	1								5	80%	41%	119%
HSG																																						2	2	15								19	79%	61%	97%
HSS																																									4							4	100%	88%	113%
HPB, HPW																																										5						5	100%	90%	110%
HSV, HFA																																						2				13						15	87%	69%	104%
VSC																																											2	2				4	50%	-4%	104%
VBS																																												3	1			4	75%	27%	123%
VEB																																													18				18	100%	97%	103%
OMISSION: Total	5	4	6	7	3	2	52	6	27	29	9	4	50	2	1	2	24	3	5	25	31	21	25	6	3	4	4	16	19	42	3	30	25	4	5	23	8	30	33	8	17	4	7	13	2	5	19	673			
PRODUCERS' ACCURACY	100%	100%	83%	71%	100%	100%	94%	83%	85%	97%	33%	75%	86%	50%	100%	100%	92%	33%	100%	80%	87%	90%	96%	83%	100%	100%	100%	94%	79%	74%	100%	90%	80%	100%	100%	100%	88%	100%	88%	50%	88%	100%	71%	100%	100%	60%	95%	589			
90% Confidence Interval -	90%	88%	50%	36%	75%	99%	88%	50%	72%	89%	2%	27%	77%	-33%	50%	75%	80%	-28%	90%	65%	76%	78%	88%	50%	83%	88%	88%	81%	61%	61%	83%	79%	65%	88%	90%	98%	62%	98%	77%	15%	72%	88%	36%	96%	75%	14%	84%	Total Samples = 673			
90% Confidence Interval +	110%	113%	117%	107%	125%	101%	101%	117%	98%	104%	65%	123%	95%	133%	150%	125%	103%	95%	110%	95%	99%	103%	104%	117%	117%	113%	113%	107%	97%	86%	117%	101%	95%	113%	110%	102%	113%	102%	99%	85%	104%	113%	107%	104%	125%	106%	106%	Total Correct = 590			

OVERALL ACCURACY = 87.7% KAPPA INDEX = 87.2 KAPPA INDEX LOWER 90% CONFIDENCE LEVEL = 85.0 KAPPA INDEX UPPER CONFIDENCE LEVEL = 89.4

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.

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U.S. Department of the Interior

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