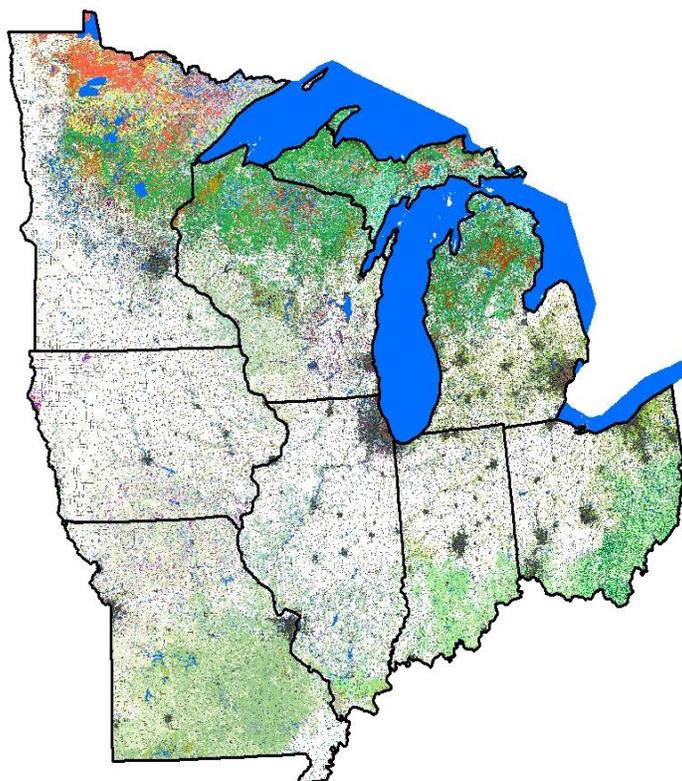


The Northeastern and Upper Midwestern Terrestrial Habitat Classification and Habitat Map Final Report



Prepared for:

The Northeastern Area Association of State
Foresters



Submitted by:

Regan Smyth, Jim Drake, and Shannon Menard



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Introduction

In 2010, the Northeastern Area Association of State Foresters (NAASF) contracted with NatureServe to (1) complete a habitat classification of Northeastern and Upper Midwestern Terrestrial Systems, and (2) provide an updated GIS-based map of those wildlife habitat systems across the eight Midwestern states. This work was supported by the Doris Duke Charitable Trust, state Natural Heritage programs and wildlife agencies as a means to develop regionally consistent data for State Forest Resource Plans and State Wildlife Action Plans (SWAPs).

NatureServe ecologists worked to classify, describe, and map upland and wetland wildlife habitats across the Midwest United States using standardized ecological classifications including the US National Vegetation Classification System (US-NVC) and the NatureServe Terrestrial Ecological Systems classifications. These classifications are used to link together individual state forest and habitat classifications. Available mapped information was reviewed and updated in order to best depict these standardized natural resource concepts. These regionally consistent digital maps are now available for use in conservation and natural resource management decisions across the Northeast and Midwestern states.

This document provides an overview of the methods and results of the Midwest phase of the classification and mapping project. (A similar effort for the Northeastern states was completed in 2008, with additional map edits occurring through 2012.) The classification and map seek a balance between the state-based habitat classifications and consistency across the region. This will assist conservation partners in working on common goals that cross state boundaries. Applications could include assessment of natural resource conditions and provision of ecological services, planning for habitat enhancements and restoration, or prioritizing investments in open space conservation. By updating the existing maps and classifications, with clear links to the multi-leveled US-NVC and Ecological Systems concepts, this product allows for map displays and analyses at varying levels of detail. The consistent classification and map will allow wildlife managers and foresters to better collaborate regionally to maximize the impact of their investments.

Northeastern and Upper Midwestern Terrestrial Habitat Classification (NMTHCS)

The first component of this project was to review and revise the vegetation classification to be used for the final map and to establish the link between these classification units and those used for each state's SWAP habitat classification. The concept and distributions of the individual Systems have been developed and refined over the past decade by NatureServe ecologists with input from other experts in federal, state, and local partner organizations. We began with a list of 102 Ecological Systems attributed to the eight states in our project area and reviewed and revised it to ensure it agreed with our current understanding of the concepts and distribution of the Systems. Changes to the distribution or concepts of Systems were made, as appropriate.

Individual SWAP habitat classifications are not the same from state to state so comparing data from one state to another is difficult. We established the relationship of Ecological Systems to SWAP units to

create a uniform classification system across the region so users could compare data across state lines. We began by collecting SWAP habitat classifications from all eight states in the project area. We then determined how each SWAP unit compared to Ecological Systems. We only used the SWAP habitat units that represented natural or near-natural vegetation communities. We did not consider agricultural, developed, or non-natural successional habitats such as Cave/Mine, Old Field, or Deep Lake habitat units. After completing the crosswalk to Systems, we established the relationship, of Associations, the finest level of the National Vegetation Classification, to SWAP habitat units. We did not use Associations in our mapping effort but this crosswalk provides a more detailed method of comparing data across state lines, if users desire.

Appendix A contains full classification information on all Ecological Systems attributed to the project area. There are 107 natural/semi-natural Systems that are included in the map legend and three unmapped Systems that are also attributed to the project area.

GIS-based Map of Wildlife Habitat Systems across the Eight Midwestern States

The primary output of the second component of this project is an updated GIS-based map of wildlife habitat systems across the eight Midwestern states, appropriate for use at regional and sub-regional scales. This map utilizes the NMTHCS to provide information on the distribution and extent of habitats in a form that facilitates effective communication about habitats across jurisdictions, both within the Midwest and in adjacent regions.

The map is provided to users as a 30-meter resolution grid, with each pixel classified as a unique ecological system type. Ecological Systems represent recurring groups of biological communities that are found in similar physical environments and are influenced by similar dynamic ecological processes, such as fire or flooding. They are intended to provide a classification unit that is readily able to be mapped, often from remote imagery, and readily identifiable by conservation and resource managers in the field.

While the finest level of thematic resolution of the habitat map is at the Systems level, the data contain attribute information that allows display of habitat types at different categorical scales, including US-NVC Divisions, Subclasses, Classes, and Formations, as well as classes used in the National Landcover Data Set, and upland versus wetland vegetation.

Intended uses of the habitat classification and map product include, but are not limited to:

- Exploration of regional biodiversity patterns
- Improved communication about habitats across state and other jurisdictional boundaries
- Identification of habitats likely to be found within a specific project area
- Regional assessments of the extent and condition of particular habitat types
- Regional assessments of ecological service provision
- Prioritization of habitat conservation activities
- Selection of candidate sites for monitoring, assessment, or habitat restoration projects

The map product is compatible with the Northeastern Terrestrial Habitat Classification System (NETHCS) map produced by The Nature Conservancy (TNC 2011) although there are differences in the mapping methodology, and resulting map products, between the two regions. These differences are discussed further in the Discussion section of this report.

Methods

To arrive at the final geodatabase containing both the existing vegetation map and representations of vegetation structure, we completed a multi-step process of identifying deficiencies in existing vegetation maps, applying expert knowledge and statistical models to perform map revisions, and checking the map against observation data. This work proceeded in six steps.

1. Review of existing vegetation maps

Several vegetation mapping products cover all or portions of the Midwestern states. As a first step, we compiled and evaluated available vegetation map products, including Existing Vegetation Cover (EVT) as mapped by Landfire (2010), the Southeast Gap land cover map (BASIC 2010), and Northeastern Terrestrial Habitat Classification System (NETHCS) map produced by The Nature Conservancy (TNC 2011).

The Landfire EVT is mapped using predictive landscape models based on extensive field reference data, satellite imagery, biophysical gradient layers, and classification and regression trees (CART). The 2008 refresh incorporates disturbance and its severity, both managed and natural, which occurred on the landscape after 2001. Vegetation is mapped at the scale of 30-meter resolution pixels, although the dataset is intended to support regional planning efforts and is not intended to be interpreted at fine scales. Vegetation is classified using NatureServe's Ecological System Classification (Comer et al. 2003). (Landfire 2010)

The Southeast Gap land cover dataset was developed by modeling natural and semi-natural vegetation using Landsat ETM+ imagery from multiple seasons from 1999-2001 in conjunction with digital elevation model (DEM) derived datasets such as elevation and landform. The minimum mapping unit for the Gap data is 0.4 ha (1 acre) and vegetation classes are drawn from NatureServe's Ecological System Classification (Comer et al. 2003). (BASIC 2010)

The NETHCS map (Gawler et al. 2008) does not overlap with the project area, but was reviewed for consistency across classification schemes and general compatibility, as previously discussed in this report.

NatureServe's existing national aggregate map of Ecological Systems brings together the Landfire EVT and Southeast Gap land cover products; it was used as the starting point for further map review and refinements. Within the project area, the aggregate map is primarily based on the Landfire EVT data, with the exception of the portions of Map Zones 47 and 53 in southern Ohio and Illinois, where the SE Gap land cover map was used as the default data source.

In order to facilitate the initial review of the map, we calculated the total area mapped in each type, and looked at the breakdown in the distribution of that area across USFS ecoregions. NatureServe's regional ecologists used that information to flag Systems that appeared to be over-represented or under-represented in the region as a whole, Systems that were mapped outside their expected range, and Systems that were not mapped at all in ecoregions where they are known to occur.

2. Development of Observation GeoDatabase

In order to evaluate existing maps and create deductive models, it is necessary to first have georeferenced records of known occurrences of particular vegetation types. To this end, we created a geodatabase of sample data compiled from multiple sources, including community element occurrence records from all eight states in the project area, classified wetland monitoring plots in Michigan and Ohio (Faber-Langendoen et al. 2011), and detailed vegetation maps from National Park Service Units including Apostle Islands NL, Effigy Mounds NM, Grand Portage NM, Indiana Dunes NL, Isle Royale NP, Ozarks NSR, Pictured Rocks NL, Saint Croix NSR, Sleeping Bear Dunes NL, and Voyageurs NP. (Individual project data and results at http://www.usgs.gov/core_science_systems/csas/vip/products.html.) Source data were classified using different units than the NMTHCS so we could not use the maps directly. NPS and wetland monitoring plots were classified to the USNVC association level and community element occurrence records were classified using the vegetation classification criteria of the individual states. NatureServe has established the relationship of all of these units to the Ecological Systems used for the NMTHCS. Thus, we were able to apply the NMTHCS classification units to all of these base data. In total, over 15,000 point or polygon occurrences of 114 vegetation types are represented in the observation geodatabase and were used for map validation and model development.

3. Map Validation / Accuracy Assessment

In order to assess the accuracy of the base map, and target Systems for revisions, we undertook both a quantitative map validation using data in the observation geodatabase and a systematic type-by-type visual review of the distribution of all mapped types. Systems that were flagged earlier as having distributions that were over or under-represented in the region as a whole, or within certain ecoregions, received additional scrutiny.

We performed a spatial intersection between the aggregate vegetation map and all polygons/points in the observation geodatabase. The results were formatted into contingency tables to summarize the degree to which observed and mapped classes were commonly confused in the original map.

In March, 2012, NatureServe ecologists held a two-day workshop to complete a type-by-type review of Systems, in which the results of the quantitative accuracy assessment were considered in conjunction with a visual examination of the extent of each mapped type. The goals of this review were to (1) identify and document misrepresentations in the source data, and (2) develop strategies for addressing and rectifying those problems. This included identifying and removing map classes that should not have been included in the original map, such as Great Plains or Gulf Coast Systems that were errantly included. The workshop was followed by additional internal map review of Systems not adequately covered during the workshop, as well as consultation with outside experts, particularly to review Systems in the southwestern portion of the project area (i.e. Missouri). Dave Diamond, Lee Elliott, Mike

Leahy, Ian MacFarlane, and Paul Nelson participated in a web meeting to make recommendations on how to best improve the Systems map in this area.

Outcomes of the map review, including observations on the general accuracy of mapped types in the source data, are included in Appendix B.

4. Development of Supporting Biophysical Data Sets

In several cases, the strategies identified for improving errors in the source data required the development of biophysical data sets. Spatial data on soils, hydrology, and canopy cover were used to improve the mapped distribution of several mapped types.

We obtained a compilation of spatial data representing the national NRCS Soil Survey Geographic (SSURGO) Database (NRCS 2007) for all Landfire map zones. We used this data to generate seamless raster data sets representing key soils attributes for the complete project area. These included percent clay, percent histosols, percent sand, and variables characterizing wet soils including water holding capacity, depth to restrictive layer, saturated hydrologic conductivity and drainage class.

Using the 10-meter resolution national elevation dataset available from USGS, we derived several hydrology related metrics, including flow accumulation and Topographic Convergence Index. Flow accumulation is a measure of the number of cells flowing into a given cell on the raster surface, and of potential value in defining floodplains and other wetland features. Topographic Convergence Index (TCI) quantifies the likelihood of saturation (Dilts 2010). Because of the fine spatial resolution of this data, these DEM-derived data layers were processed at sub-regional scales for only those areas relevant to the Systems of interest.

Canopy cover data and structure data were obtained from Landfire (Landfire 2010).

5. Completion of Regional Habitat Systems Map

Using NatureServe's aggregate map of Ecological Systems as a starting point, we completed map revisions affecting seventy map classes and approximately twenty percent of the total mapped area.

Revisions were generally of one of three types:

- (1) Inductive, or expert-driven, models
- (2) Deductive, or data-driven, models
- (3) Burning in rare types comprehensively surveyed and mapped by state heritage programs.

Appendix B details what changes, if any, were made to the distribution of each individual system for the final map.

Expert-knowledge driven changes included many range restrictions, wherein a system mapped outside its known range was reclassified to another similar system more likely to occur in those areas. Ecoregional boundaries (section or subsection; Omernik 1987) were used to define rules for geographic restriction. In some cases, biophysical constraints, such as elevation restrictions, were also enforced.

Deductive modeling was employed when we identified errors in the distribution of a system in the source data, but more information was needed to determine rules for restricting or expanding the mapped area. We used classification and regression tree (CART) models to identify those variables, and determine which variable values were best able to segregate the Systems of interests (De'ath and Fabricius 2000). We used natural heritage element occurrence data to train the models, retaining 20 percent of the training data for use in model validation. Biophysical data included as potential predictive variables included soil variables, distance to streams, elevation, and other DEM-derived datasets discussed in Section 4.

Finally, for rare types not well represented in the source data and not able to be modeled with sufficient accuracy, we used spatial data of known occurrences to burn polygon features representing these types directly into the raster map. Areas mapped as these types in the source data, but located outside of polygons of known occurrences, were reclassified to another system. All Systems for which we applied this approach are of special conservation or management interest and have been extensively surveyed in the areas where they occur and thus the survey data (element occurrence records and prairie maps) provide a better representation than the Landfire source data.

Natural Heritage element occurrence polygons were our primary data source for spatial data to burn in these types; prior to using these records, we filtered them to remove all polygons last observed prior to 1990 from the data set. In Minnesota, a comprehensive map of prairie lands was available (MN DNR 2012) and used to burn in prairies in place of the standard element occurrence (EO) records. We filtered these prairie data to include only grasslands greater than 0.25 acres and to exclude sites where the comments or past land use attributes indicated likely agricultural impacts. Ecoregional boundaries were used to assign prairie polygons to either Northern Tallgrass Prairie (Sections 251A, 251B, and subsections 222Na, 222Ma, 222Mb, 222Mc, and 222Md) or Central Tallgrass Prairie (all other ecoregions in Minnesota). In Iowa, EO data were only available in the form of occurrence points. We intersected these points with habitat patches from the source Systems data (the source raster was first converted to polygons) and then used these selected patches when burning the EO occurrences into the map. For Central Tallgrass Prairie, we applied a buffer distance of 100 meters to selected intersecting polygons. For the other rare types, we visually examined each EO and added all adjacent polygons that appeared part of the same complex. For North-Central Interior Sand and Gravel Tallgrass Prairie, we also considered sandy soils, as mapped by SSURGO, while making those determinations.

All changes to the map were performed individually for each system using spatial analyst functions in ArcMap, and were then merged back in with the master Systems map.

6. Representation of Vegetation Structure

Vegetation structure data are provided in the project geodatabase as a series of raster data sets separate from the raster data representing existing vegetation type. We evaluated the availability of vegetation structure data from multiple sources. However, only Landfire provided a regionally-consistent, up-to-date data set for the entire Midwest. The structure data provided in the project geodatabase represents 2008-revised representations of existing vegetation cover and forest canopy

cover, as downloaded from Landfire and merged for all map zones covering the project area (Landfire 2010).

Results and Products

The outcomes of this undertaking include the Northeastern and Upper Midwestern Terrestrial Habitat Classification (Appendix A), a geodatabase containing the updated Midwest map of Ecological Systems and Landfire vegetation structure data, a tabular summary of map accuracy and updates by system (Appendix B), and this report. A recorded PowerPoint presentation demonstrating the data and providing examples of how the Systems map can be applied to address varied natural resource management needs has also been made available by NatureServe.

Most states had SWAP habitat units that were more generalized than Systems so the relationship was usually more than one System fitting within one SWAP habitat unit (Table 1). For six of the eight states the relationship averaged 2-3 times as many Systems as SWAP units. Two states, Missouri and Wisconsin, used detailed natural community classifications to define their SWAP habitat units and in those cases most of their units were equal to or finer than Systems. Sometimes, the relationship was difficult to determine due to the brief description of the SWAP habitat unit or the different conceptual bases used to establish the SWAP units compared to Systems. This was particularly common for SWAP habitat units that appeared to be largely aquatic. For example, the habitat classes called River – Headwater to Large and River – Very Large in Minnesota do not appear to include floodplain forests or emergent wetland stands but this is not entirely clear to us.

Table 1. Comparison of SWAP Habitat Units, Ecological Systems, and NVC Associations by state.

State	Natural/Semi-natural Vegetation SWAP Classes	Ecological Systems	NVC Associations
Iowa	8	16	86
Illinois	18	40	137
Indiana	11	32	133
Michigan	22	47	205
Minnesota	31	54	178
Missouri	71	38	131
Ohio	7	44	106
Wisconsin	65	49	170

The crosswalk of Associations to SWAP habitat units was typically straightforward. Since Associations were usually much finer than SWAP habitat units, they usually fit neatly into a single SWAP type. Wetlands were the most complex since some wetland Associations can occur in basin and riverine wetlands.

The vegetation map data are stored in the geodatabase as a 30-meter resolution raster file. It contains an imbedded colormap to facilitate display, and includes a raster attribute table which allows the data to be queried and displayed at different levels of the National Vegetation Classification hierarchy. Users can thus manipulate the data to support projects requiring a representation of vegetation type at finer (e.g. Systems) or coarser (e.g. Divisions or Subclasses) scales.

FDGC-compliant metadata is provided with the spatial data sets. Appendix B of this report provides a full documentation of all changes made to the source data, as well as observations on the accuracy of each mapped Systems, known short-comings in the mapping of some vegetation types, and recommendations on how some of those short-comings can be address given additional data or at local scales of analysis.

Discussion

The Northeastern and Upper Midwestern Terrestrial Habitat Classification and map provide a valuable tool for conservation partners working on common goals, particularly across state boundaries. The updated map and classification, with links to the multi-leveled US-NVC and Ecological Systems, are designed to facilitate communication across jurisdictions while providing a framework well-suited for a diversity of applications at different geographic and thematic scales. The data provided here offer a foundation for depicting ecological diversity in terms of location, type, condition, and trend in natural habitats and can be applied to many forms of resource decision making.

Users should be cognizant that while habitat is mapped at a resolution of 30-meter pixels, this product is designed primarily to support regional planning efforts and should not be used at very fine scales (i.e., at the level of a pixel or group of pixels). Use of this map in conjunction with local products and/or ground-truthing of the data is recommended for projects carried out at scales below the sub-regional level. The thematic resolution at which the map should be applied will depend on the needs of the end user, keeping in mind that thematic accuracy often increases when thematic resolution decreases (e.g., the map is likely to be more accurate in differentiating between forests and grasslands than in differentiating between similar Systems such as Beech-Maple Forest and Maple-Basswood Forest).

Every effort was made to maximize the accuracy of the final map. However, for some Systems, our ability to successfully map vegetation was limited by the availability of spatial data. Many Systems that occur predominantly as small patches on the landscape are particularly prone to errors, especially where they occur at scales below the spatial resolution of data sets available for modeling. Some small-patch Systems are not included in the map. Others rare types were drastically over-represented in the Landfire source data (e.g. many prairie Systems). Using natural heritage element occurrence records vastly improved the mapping of these types, but this approach risks excluding any sites that are not included in heritage databases.

Confusion in mapped types also arises when other Systems have similar bio-physical affinities and similar spectral signatures, and thus are difficult to tease apart even given the best available spatial data sets. Careful review of mapped extent by knowledgeable ecologists, as well as enforcement of

limitation by ecoregional boundaries improved the mapping of some of these types, but is an imperfect fix. Floodplain Systems often proved difficult to accurately map. We attempted modeling using hydrography and terrain variables to better identify floodplain Systems, but a detailed and accurate region-wide map of floodplains would allow a much better mapping of these types and would be worth pursuing in the future.

The mapping of human-influenced types (e.g. developed areas and agricultural lands) depicted in the source Landfire data was based on the National Land Cover Data Set (NLCD; citation). In the course of map review, it became apparent that the NLCD often misrepresented agricultural lands, attributing them to natural types (e.g. prairies) in some areas, and not capturing agriculture where it occurred elsewhere. It was beyond the scope of our project to directly address errors in the NLCD, although when it was possible to improve the mapping of natural types we did so. The ephemeral nature of cropland compounds the problem, as land that was in cultivation when the source data were generated may transition to a semi-natural or natural type by the time the map is applied.

The map product is compatible with the Northeastern Terrestrial Habitat Classification System (NETHCS) map produced by The Nature Conservancy (Gawler et al. 2008). Because the Northeastern and Midwestern classifications both conform to the national standard and were developed across jurisdictions, the base data allow for consistent application across the two regions. However, map users undertaking analyses across the Northeast/Midwest boundary should be aware that due to differing mapping approaches and rules for assigning mapped types in the Northeast and Midwest, patterns in the distribution of some Systems differ across the regional boundary. The Midwest map is primarily based on interpretation of remotely sensed imagery using a combination of inductive (expert-driven) and deductive (CART) modeling, with the minimum mapping unit (MMU) at the pixel scale. The Northeast map was developed using a range of environmental datasets and known occurrence data to run RandomForest models at the scale of 100-acre hexagons, with smaller-patch types burned into the hexagon matrix. Consequently, the Midwest map is relatively pixelated but may better represent more recent disturbances to the landscape, whereas the Northeast map provides a smoother representation of habitats based on environmental variables, but may miss some fine scale variation and fail to capture disturbance not well represented in the National Land Cover Dataset. Both the Northeast and Midwest maps incorporate the SEGAP product where available and both use ecological system types to guide the mapping process.

While the map data provided here provide a sound basis for regional conservation planning efforts, given additional resources, we would recommend several further map refinements. These include better modeling of small patch and floodplain systems and a closer review of the mapping of human-influenced types.

The utility of the map product would also be enhanced by working with SWAPs to directly link their wildlife information to the classification and spatial data provided here. Doing so could better inform species-habitat relationships and assist in the delimitation of priority species and species groups. For example, a publication characterizing the ecological grouping of priority species using spatial information to arrive at “functional groupings” of birds, small mammals, plants, and invertebrates could

facilitate planning by SWAP partners. Translating species-habitat relationships into mapped habitat ranges for priority species and species groups would also be a logical next step. Finally, by using the map in conjunction with data on habitat disturbances and landscape condition, it will be possible to characterize the quality of key habitats.

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APPENDIX A:

**INTERNATIONAL ECOLOGICAL
CLASSIFICATION STANDARD:**

TERRESTRIAL ECOLOGICAL CLASSIFICATIONS

**ECOLOGICAL SYSTEM DESCRIPTIONS FOR THE UPPER
MIDWESTERN TERRESTRIAL HABITAT CLASSIFICATION AND MAP**

17 May 2013

by

NatureServe

4600 North Fairfax Drive, 7th Floor
Arlington, VA 22203

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

This subset of the International Ecological Classification Standard covers Ecological System Descriptions for the Upper Midwestern Terrestrial Habitat Classification and Map. 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 Jim Drake, Regional Vegetation Ecologist, Minneapolis, MN <jim_drake@natureserve.org>.



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Citations:

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

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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, Quarry Heights, Panama; Centro de Datos para la Conservacion de Paraguay, San Lorenzo, Paraguay; Centro de Datos para la Conservacion de Peru, Lima, Peru; Centro de Datos para la Conservacion de Sonora, Hermosillo, Sonora, Mexico; Netherlands Antilles Natural Heritage Program, Curacao, Netherlands Antilles; Puerto Rico-Departamento De Recursos Naturales Y Ambientales, Puerto Rico; Virgin Islands Conservation Data Center, St. Thomas, Virgin Islands.

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

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1. FOREST TO OPEN WOODLAND

1.B. Temperate & Boreal Forest

1.B.1. WARM TEMPERATE FOREST

1.B.1.Na. Southeastern North American Warm Temperate Forest

M008. SOUTHERN MESIC MIXED BROADLEAF FOREST

G166. Southern Mesic Beech - Oak - Mixed Deciduous Forest

CE203.079 CROWLEY'S RIDGE MESIC LOESS SLOPE FOREST

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Forest and Woodland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Unglaciated

National Mapping Codes: EVT 2322; ESLF 4128; ESP 1322

Concept Summary: This ecological system of mesic upland forests is confined to Crowley's Ridge, along the western side of the lower Mississippi River, extending from Missouri south into Arkansas. This vegetation and the ridge itself are very distinctive from that of the adjacent alluvial plain. The ridge is a remnant loess-capped feature rising from 30 m to over 60 m (100-200 feet) above the alluvial plain surface, to about 150 m (450 feet) above sea level. The base of the ridge is comprised of Tertiary substrates overlain by Quaternary alluvial deposits and capped with up to 15 m (50 feet) of Pleistocene loess. The system is generally comprised of mesic forests that occupy ravines between narrow, "finger" ridges and slopes in a highly dissected landscape. The sites tend to be more mesic than sites elsewhere in the southeastern United States. In many cases, these slopes and ravines provide habitat for plant species that are rare or absent from other parts of the alluvial plain (e.g., *Liriodendron tulipifera*, *Tilia americana*). Canopies are dominated by *Fagus grandifolia*, *Quercus alba*, and *Liriodendron tulipifera*, with many associates.

Comments: This type does not include all forests across the entire extent of southern Crowley's Ridge; excluded are dry and dry-mesic forests, typically on west-facing slopes and ridgetops. This system is best developed on southern Crowley's Ridge where loess is most pronounced, and becomes much more isolated and rare on the ridge north of approximately Jonesboro, Arkansas. Conversely, dry-mesic oak and shortleaf pine communities are rare within this system, becoming dominant on western slopes and in the northern ridge, respectively. The vegetation may share some superficial similarities with types referred to as western mesophytic forests, but it is well-separated geographically from these. A similar ecological system is East Gulf Coastal Plain Northern Loess Bluff Forest (CES203.481) which occurs farther eastward and is restricted to the loess bluffs east of the Mississippi River. The vegetation of these areas is believed to share a great deal of overlap. They are recognized as distinct for now due to geographic separation; further work may suggest that these two systems should be merged. There are a number of state parks and small natural areas on Crowley's Ridge, including Village Creek State Park, Crowley's Ridge State Park, Wittsburg Natural Area and Chalk Bluff Natural Area (which is toward the northern end of the ridge). All of these have moderate to high-quality examples of this system.

DISTRIBUTION

Range: This system is endemic to Crowley's Ridge (Arkansas, Missouri), which is a distinctive landscape feature in the Mississippi River Alluvial Plain.

Divisions: 203:C

TNC Ecoregions: 42:C

Nations: US

Subnations: AR, MO

Map Zones: 45:C

USFS Ecomap Regions: 234D:CC

CONCEPT

Associations:

- *Quercus alba* - *Quercus rubra* - *Acer saccharum* - *Carya cordiformis* / *Lindera benzoin* Forest (CEGL002058, G3?)
- *Quercus alba* - *Quercus falcata* - *Quercus velutina* / *Ostrya virginiana* Forest (CEGL004068, G1G2)
- *Quercus (rubra, alba, velutina)* / *Acer barbatum* / *Asimina triloba* Forest (CEGL004069, G1G2)
- *Fagus grandifolia* - *Quercus (alba, rubra)* / *Acer barbatum* / *Asimina triloba* Forest (CEGL004072, G2G3)

Environment: These diverse-canopy forests occur in ravines in a highly dissected environment. The system is best expressed on southern Crowley's Ridge, Arkansas (Cross County south through Phillips County), with additional limited occurrences to the north, in undisturbed valleys and coves. Deep loessal soil is the most characteristic and diagnostic component of the environment of this system.

Vegetation: This system consists of forests that are typically dominated by beech, oaks and other hardwoods. Canopies are dominated by *Fagus grandifolia*, *Quercus alba*, and *Liriodendron tulipifera*, with many associates. Other oaks which may be present include *Quercus rubra*, *Quercus falcata*, and *Quercus velutina*. Due to the apparent richness of the loessal soils, *Ostrya virginiana* is a particularly common species across many of the component community types. Species that may be present in the shrub layer include *Arundinaria gigantea*, *Asimina triloba*, *Bignonia capreolata*, *Lindera benzoin*, *Parthenocissus quinquefolia*, *Toxicodendron radicans*, and *Vitis rotundifolia*. Some possible herbs include *Cynoglossum virginianum*, *Dioscorea quaternata*, and *Sanicula canadensis*.

Dynamics: These are stable, generally fire-sheltered forests, with relatively low fire frequency and intensity. There is presumably some natural disturbance from the effects of windstorms and collapse of the fragile loess.

SOURCES

References: Clark 1974, Eyre 1980, NatureServe Ecology - Southeastern U.S. unpubl. data, Nelson 2005, Southeastern Ecology Working Group n.d.

Version: 23 Feb 2010

Concept Author: T. Foti, D. Zollner, M. Pyne

Stakeholders: Midwest, Southeast

LeadResp: Southeast

1.B.2. COOL TEMPERATE FOREST

1.B.2.Na. Eastern North American Cool Temperate Forest

M012. NORTH-CENTRAL OAK - HARDWOOD & PINE FOREST

G181. North-Central Oak Savanna & Barrens

CES202.698 NORTH-CENTRAL INTERIOR OAK SAVANNA

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Steppe/Savanna

Spatial Scale & Pattern: Matrix

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

National Mapping Codes: EVT 2394; ESLF 5410; ESP 1394

Concept Summary: This system is found primarily in the northern glaciated regions of the Midwest with the largest concentration in the prairie-forest border ecoregion. It is typically found on rolling outwash plains, hills and ridges. Soils are typically moderately well-to well-drained deep loams. This system is typified by scattered trees over a continual tallgrass prairie. *Quercus macrocarpa* is the most common tree species and can range from 10-60% cover. The understory is dominated by tallgrass prairie species such as *Andropogon gerardii* and *Schizachyrium scoparium* associated with several forb species. Historically, frequent fires maintained this savanna system within its range and would have restricted tree canopies to 10-30%. Fire suppression in the region has allowed trees to establish more dense canopies. Periodic, strong wind disturbances and browsing also impact this system. Much of this system has also been converted to agriculture, and thus its range has decreased considerably.

DISTRIBUTION

Range: This system is found throughout the northern glaciated regions of the Midwest. Its main concentration, where it was likely the matrix type, is within the Prairie Forest Border of Minnesota, Wisconsin, Iowa, and Illinois. Conversion to agriculture and fire suppression have significantly impacted the range of this system.

Divisions: 201:?, 202:C, 205:C

TNC Ecoregions: 35:C, 36:C, 45:P, 46:C, 47:P

Nations: US

Subnations: IA, IL, IN, MI?, MN, MO, WI

Map Zones: 39:P, 40:C, 41:C, 42:C, 43:P, 44:P, 49:C, 50:C, 51:P, 52:C

USFS Ecomap Regions: 212K:CP, 212Q:CP, 222Jb:CCP, 222Jc:CCC, 222Je:CCC, 222Jf:CCC, 222Jg:CCC, 222Jh:CCC, 222Ji:CCC, 222K:CC, 222L:CC, 222M:CC, 222N:CC, 222Ua:CCC, 222Ud:CCC, 222Ue:CCC, 251A:CC, 251B:CC

CONCEPT

Associations:

- *Quercus macrocarpa* Northern Tallgrass Wooded Herbaceous Vegetation (CEGL002158, G1G2)
- *Quercus macrocarpa* - (*Quercus alba*, *Quercus velutina*) / *Andropogon gerardii* Wooded Herbaceous Vegetation (CEGL002020, G1)

- *Quercus alba* - *Quercus macrocarpa* / *Andropogon gerardii* Wooded Herbaceous Vegetation (CEGL005121, G1)
- *Quercus macrocarpa* - *Quercus palustris* - *Quercus bicolor* / *Calamagrostis canadensis* Wooded Herbaceous Vegetation (CEGL005120, G1)
- *Quercus alba* - *Quercus macrocarpa* - *Quercus rubra* / *Corylus americana* Woodland (CEGL002142, G3G4)
- *Quercus macrocarpa* - (*Quercus alba*, *Quercus stellata*) / *Andropogon gerardii* Wooded Herbaceous Vegetation (CEGL002159, G1)

High-ranked species: *Anisota manitobensis* (G1G2Q), *Dichagyris reliqua* (G2G3), *Erynnis persius persius* (G5T1T3), *Myotis sodalis* (G2), *Nicrophorus americanus* (G2G3), *Oarisma poweshiek* (G1), *Papaipema beeriana* (G2G3), *Sisyrinchium strictum* (G2Q)

Environment: This system is typically found on rolling outwash plains, hills and ridges. Soils are typically moderately well- to well-drained deep loams. This system is typified by scattered trees over a continual tallgrass prairie.

Vegetation: *Quercus macrocarpa* is the most common tree species and can range from 10-60% cover. The understory is dominated by tallgrass prairie species such as *Andropogon gerardii*, *Calamagrostis canadensis*, and *Schizachyrium scoparium* associated with several forb species.

Dynamics: Historically, frequent fires maintained this savanna system within its range and would have restricted tree canopies to 10-30%. Fire suppression in the region has allowed trees to establish more dense canopies. Periodic, strong wind disturbances and browsing also impact this system. Much of this system has also been converted to agriculture, and thus its range has decreased considerably.

SOURCES

References: Albert 1995b, Comer et al. 1995a, Comer et al. 1998, Comer et al. 2003, MNNHP 1993

Version: 18 Jul 2006

Stakeholders: Midwest, Southeast

Concept Author: S. Menard

LeadResp: Midwest

CES202.727 NORTH-CENTRAL OAK BARRENS

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Steppe/Savanna

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Woody-Herbaceous

National Mapping Codes: EVT 2395; ESLF 5411; ESP 1395

Concept Summary: This community occurs on well-drained, coarse-textured sandy soils derived from glacial outwash, end moraine formations, or lakeplain dune systems in the north-central U.S. into Ontario, Canada. Soils range from almost pure sand, to loamy sand, to sandy loam. The soils have low fertility, organic matter, and moisture-retention capacity. Factors which affect seasonal soil moisture are strongly related to variation in this type. This oak barrens system is a scrubby, open-treed system dominated by graminoids and shrubs. Canopy structure varies from a dominant herbaceous ground layer with sparse, scattered "savanna" canopy (5-30%), through oak-dominated scrub, to a more closed woodland canopy (30-80%). The canopy layer is dominated by *Quercus velutina*, with some *Quercus ellipsoidalis*, *Quercus macrocarpa*, and *Quercus alba* (the latter more common eastward and in woodland conditions). Occasional *Pinus banksiana* can occur in the northern parts of the range. Species found in the herb layer include *Ambrosia psilostachya*, *Amphicarpaea bracteata*, *Artemisia ludoviciana*, *Andropogon gerardii*, *Calamovilfa longifolia*, *Carex pennsylvanica*, *Carex* spp., *Comandra umbellata*, *Sorghastrum nutans*, *Hesperostipa spartea* (= *Stipa spartea*), and *Schizachyrium scoparium*. Fire was an important factor in maintaining this community. Oak wilt and droughts also reduce tree cover.

Comments: Black oak woodland variants may occur in this system, but because *Quercus velutina* and *Quercus ellipsoidalis* can sprout after stems have been killed by fires, stands generally have a somewhat scrubby structure that can vary from 10-60% cover over time. Some stands may occur on fairly mesic sands. In New England and (most of) New York, similar settings are occupied by pitch pine - oak barrens (Northeastern Interior Pine Barrens (CES202.590)) which are characterized by *Quercus ilicifolia*, not *Quercus ellipsoidalis*.

DISTRIBUTION

Range: This system is found in the north-central U.S. from North Dakota to western New York and westernmost Pennsylvania (mostly historic there) and into Ontario, Canada.

Divisions: 202:C

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

Nations: CA, US

Subnations: IL, IN, MI, MN, ND, NY, OH, ON, PA, WI

Map Zones: 39:C, 40:C, 41:C, 42:C, 43:C, 49:C, 50:C, 51:C, 52:C, 63:C

USFS Ecomap Regions: 212Ha:CCP, 212Hb:CCC, 222I:CC, 222Ja:CCC, 222Jb:CCC, 222Jc:CCC, 222Je:CCC, 222Jf:CCC, 222Jg:CCC, 222Jh:CCC, 222Ji:CCP, 222K:CC, 222L:CC, 222M:CP, 222R:CC, 222Ua:CCC, 222Ud:CCC, 222Ue:CCC

CONCEPT

Associations:

- *Quercus velutina* - (*Quercus alba*) - *Quercus ellipsoidalis* / *Schizachyrium scoparium* - *Lupinus perennis* Wooded Herbaceous Vegetation (CEGL002492, G3)
- *Quercus velutina* - (*Quercus ellipsoidalis*) - *Quercus alba* / *Deschampsia flexuosa* Woodland (CEGL005029, GNR)
- *Quercus alba* - (*Quercus velutina*) / *Lespedeza virginica* - *Eupatorium hyssopifolium* Woodland (CEGL006433, GNR)
- *Quercus macrocarpa* - (*Quercus ellipsoidalis*) / *Schizachyrium scoparium* - *Koeleria macrantha* Wooded Herbaceous Vegetation (CEGL002160, G2)

High-ranked species: *Apodrepanulatrix liberaria* (G3), *Callophrys irus* (G3), *Dichagyris reliqua* (G2G3), *Erastria coloraria* (G3G4), *Erynnis martialis* (G3), *Erynnis persius persius* (G5T1T3), *Nicrophorus americanus* (G2G3), *Papaipema beeriana* (G2G3), *Phoberia ingenua* (G3G4), *Plebejus melissa samuelis* (G5T2), *Sisyrinchium strictum* (G2Q), *Tachysphex pechumani* (G2G3)

Environment: This system occurs on well-drained, coarse-textured sandy soils derived from glacial outwash, end moraine formations, or lakeplain dune systems. Soils range from almost pure sand, to loamy sand, to sandy loam. The soils have low fertility, organic matter, and moisture-retention capacity. Factors which affect seasonal soil moisture are strongly related to variation in this type.

Vegetation: This oak barrens system is a scrubby, open-treed system dominated by graminoids and shrubs. Canopy structure varies from a dominant herbaceous ground layer with sparse, scattered "savanna" canopy (5-30%), through oak-dominated scrub, to a more closed woodland canopy (30-80%). The canopy layer is dominated by *Quercus velutina*, with some *Quercus ellipsoidalis*, *Quercus macrocarpa*, and *Quercus alba* (the latter more common eastward and in woodland conditions). Occasional *Pinus banksiana* can occur in the northern parts of the range. Species found in the herb layer include *Ambrosia psilostachya*, *Amphicarpaea bracteata*, *Artemisia ludoviciana*, *Andropogon gerardii*, *Calamovilfa longifolia*, *Carex pensylvanica*, *Carex* spp., *Comandra umbellata*, *Sorghastrum nutans*, *Hesperostipa spartea* (= *Stipa spartea*), and *Schizachyrium scoparium*.

Dynamics: Fire was an important factor in maintaining this community. Oak wilt and droughts also reduce tree cover.

SOURCES

References: Chapman et al. 1994, Comer and Albert 1997, Comer et al. 1995a, Comer et al. 1998, Comer et al. 2003, Eyre 1980

Version: 11 Apr 2007

Stakeholders: Canada, East, Midwest

Concept Author: D. Faber-Langendoen

LeadResp: Midwest

G649. North-Central Oak - Hickory Forest & Woodland

CES202.047 NORTH-CENTRAL INTERIOR DRY OAK FOREST AND WOODLAND

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Forest and Woodland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Forest and Woodland (Treed); Outwash plain; Sand Soil Texture; Intermediate Disturbance Interval; F-Patch/Medium Intensity

National Mapping Codes: EVT 2311; ESLF 4117; ESP 1311

Concept Summary: This system is found throughout the glaciated regions of the Midwest, typically in gently rolling to flat landscapes. It can occur on uplands within the prairie matrix or within the context of dry-mesic oak-hickory forests and oak savannas. These are common on rolling glacial moraines and outwash plains. Soils are typically well-drained to excessively drained Mollisols or Alfisols that range from sand to sandy loam in texture. Historically, this type was quite extensive in Michigan, Indiana, Illinois, Missouri, Iowa, Wisconsin, and Minnesota. It is distinguished from other forested systems within the region by a dry edaphic condition that is transitional between dry prairies, oak barrens, or savannas and dry-mesic oak-hickory forests and woodlands. Forest cover can range from dense to moderately open canopy. Fire-resistant oak species, in particular *Quercus velutina*, *Quercus macrocarpa*, *Quercus coccinea*, and *Quercus ellipsoidalis*, dominate the overstory. *Carya glabra*, *Prunus serotina*, and *Sassafras albidum* are also common in portions of the range of this system. Depending on range of distribution and overstory canopy density, the understory may include species such as *Gaylussacia baccata* (in MI, WI, and MN), *Vaccinium angustifolium*, and *Rhus aromatica*, and/or a mixture of woodland and grassland species, including *Schizachyrium scoparium*, *Deschampsia flexuosa*, and *Carex pensylvanica*. Extreme drought, along with periodic ground and crown fire events, constitute the main natural processes for this type and likely maintained a more open canopy structure that supported oak regeneration. In fact, many current examples of this type have resulted from long-term fire suppression and conversion of oak barrens to these forests and woodlands. Fire suppression may also account for examples of this system with the more dry-mesic understory. It likely has allowed for other associates such as *Quercus rubra* and *Fraxinus americana* to become more prevalent. Extensive conversion for agriculture in the surrounding landscape with more productive soils has fragmented and isolated examples of this system. It is found primarily within the "corn belt" of the United States, and remaining large areas of this system are likely under considerable pressure due to conversion to pastureland and urban development.

Comments: This system is related to North-Central Interior Dry-Mesic Oak Forest and Woodland (CES202.046), which has white oak, red oak, and bur oak, and occurs on somewhat deeper soils; the present system has oak savannas and oak-hickory and occurs on sandplains. Applying this concept difference to drawing lines on the ground can be tricky.

DISTRIBUTION

Range: Found throughout the glaciated regions of the Midwest.

Divisions: 202:C, 205:P

TNC Ecoregions: 35:P, 36:C, 37:?, 44:?, 45:C, 46:C, 47:?, 48:C

Nations: US

Subnations: IL, IN, MI, MN, MO, ND, OH, WI

Map Zones: 38:P, 39:P, 40:P, 41:C, 42:C, 43:C, 44:P, 47:P, 49:C, 50:C, 51:C, 52:C

USFS Ecomap Regions: 212H:CC, 222H:CC, 222Ja:CCC, 222Jc:CCC, 222Je:CCC, 222Jg:CCC, 222Jh:CCC, 222Ji:CCC, 222Ua:CCC, 223A:CP, 223G:CC, 251B:CC, 251C:CC, 251D:CC, 251E:CC, 251G:CC, 251H:CC, 255A:CC, 331F:CC, 331M:CC, 332B:PP

CONCEPT**Associations:**

- *Quercus velutina* - (*Quercus ellipsoidalis*) - *Quercus alba* / *Deschampsia flexuosa* Woodland (CEGL005029, GNR)
- *Quercus velutina* - *Quercus alba* / *Vaccinium (angustifolium, pallidum)* / *Carex pensylvanica* Forest (CEGL005030, G4?)
- *Quercus ellipsoidalis* - (*Quercus macrocarpa*) Forest (CEGL002077, G4?)
- *Quercus velutina* / *Carex pensylvanica* Forest (CEGL002078, G4?)
- *Quercus velutina* - *Quercus alba* - *Carya (glabra, ovata)* Forest (CEGL002076, G4?)

High-ranked species: *Anisota manitobensis* (G1G2Q), *Crataegus distincta* (G1?Q), *Dichagyris reliqua* (G2G3), *Erynnis persius persius* (G5T1T3), *Nicrophorus americanus* (G2G3), *Plebejus melissa samuelis* (G5T2)

Environment: This system can occur on uplands within the prairie matrix or within the context of dry-mesic oak-hickory forests and oak savannas. These are common on rolling glacial moraines and outwash plains. Soils are typically well-drained to excessively drained Mollisols or Alfisols that range from sand to sandy loam in texture. Historically, this type was quite extensive in Michigan, Indiana, Illinois, Missouri, Iowa, Wisconsin, and Minnesota. It is distinguished from other forested systems within the region by a dry edaphic condition that is transitional between dry prairies, oak barrens, or savannas and dry-mesic oak-hickory forests and woodlands.

Vegetation: Forest cover can range from a dense to moderately open canopy. Fire-resistant oak species, in particular *Quercus velutina*, *Quercus macrocarpa*, *Quercus coccinea*, and *Quercus ellipsoidalis*, dominate the overstory. *Carya glabra*, *Prunus serotina*, and *Sassafras albidum* are also common in portions of the range of this system. Depending on range of distribution and overstory canopy density, the understory may include species such as *Gaylussacia baccata* (in MI, WI, and MN), *Vaccinium angustifolium*, and *Rhus aromatica*, and/or a mixture of woodland and grassland species, including *Schizachyrium scoparium*, *Deschampsia flexuosa*, and *Carex pensylvanica*.

Dynamics: Extreme drought, along with periodic ground and crown fire events, constitute the main natural processes for this type and likely maintained a more open canopy structure that supported oak regeneration. In fact, many current examples of this type have resulted from long-term fire suppression and conversion of oak barrens to these forests and woodlands. Fire suppression may also account for examples of this system with the more dry-mesic understory. It likely has allowed for other associates such as *Quercus rubra* and *Fraxinus americana* to become more prevalent. Extensive conversion for agriculture in the surrounding landscape with more productive soils has fragmented and isolated examples of this system. It is found primarily within the "corn belt" of the United States, and remaining large areas of this system are likely under considerable pressure due to conversion to pastureland and urban development.

SOURCES

References: Abrams 1992, Archambault et al. 1989, Archambault et al. 1990, Comer and Albert 1997, Comer et al. 1995a, Comer et al. 1999, Comer et al. 2003, Eyre 1980, MNNHP 1993

Version: 18 Jul 2006

Stakeholders: Midwest, Southeast

Concept Author: P. Comer, K. Kindscher, S. Menard, D. Faber-Langendoen

LeadResp: Midwest

CES202.046 NORTH-CENTRAL INTERIOR DRY-MESIC OAK FOREST AND WOODLAND

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Forest and Woodland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Forest and Woodland (Treed); Udic; F-Patch/Low Intensity; Quercus - Carya

National Mapping Codes: EVT 2310; ESLF 4116; ESP 1310

Concept Summary: This system is found throughout the glaciated regions of the Midwest, typically in gently rolling landscapes. It can occur on uplands within the prairie matrix and near floodplains, or on rolling glacial moraines and among kettle-kame topography. Soils are typically well-drained Mollisols or Alfisols that range from loamy to sandy loam in texture. Historically, this type was quite extensive in Michigan, Indiana, Illinois, Missouri, Iowa, Wisconsin, and Minnesota. Well over 700,000 hectares likely occurred in southern Michigan alone (ca. 1800). It is distinguished from other forested systems within the region by a dry-mesic edaphic condition that is transitional between dry oak forests and woodlands and mesic hardwood forests, such as maple-basswood forests. Forest cover

can range from a dense to moderately open canopy and there is commonly a dense shrub layer. Fire-resistant oak species, in particular *Quercus macrocarpa*, *Quercus rubra*, and/or *Quercus alba*, dominate the overstory. *Carya* spp., including *Carya ovata*, *Carya cordiformis*, and *Carya alba* (= *Carya tomentosa*), are diagnostic in portions of the range of this system. Depending on site location and overstory canopy density, the understory may include species such as *Corylus americana*, *Amelanchier* spp., *Maianthemum stellatum*, *Caulophyllum thalictroides*, *Laportea canadensis*, *Trillium grandiflorum*, *Aralia nudicaulis*, and *Urtica dioica*.

Occasionally, prairie grasses such as *Andropogon gerardii* and *Panicum virgatum* may be present. Fire constitutes the main natural process for this type and likely maintained a more open canopy structure to support oak regeneration. Historic fire frequency was likely highest in the prairie-forest border areas. Fire suppression may account for the more closed oak forest examples of this system with the more mesic understory. It likely has allowed for other associates, such as *Acer saccharum*, *Celtis occidentalis*, *Liriodendron tulipifera*, *Ostrya virginiana*, and *Juglans nigra*, to become more prevalent, especially in upland areas along floodplains. Periodic drought, intensified by local conditions, such as slope, southern exposure, or sandy soil, also inhibit growth of mesophytic trees. Extensive conversion for agriculture has fragmented this system. Continued fire suppression has also resulted in succession to mesic hardwoods, such that in many locations, no oak species are regenerating. Remaining large areas of this system are likely under considerable pressure due to conversion to agriculture, pastureland, and urban development.

Comments: This is the predominant oak system for the upper Midwest, and is more extensive on the landscape than the related North-Central Interior Dry Oak Forest and Woodland (CES202.047).

DISTRIBUTION

Range: Found throughout the glaciated regions of the Midwest.

Divisions: 202:C, 205:C

TNC Ecoregions: 35:C, 36:C, 44:?, 45:C, 46:C, 47:?, 48:C

Nations: US

Subnations: IA, IL, IN, KS, MI, MN, MO, ND, NE, OH, SD, WI

Map Zones: 31:C, 38:C, 39:C, 40:C, 41:?, 42:C, 43:C, 44:C, 47:P, 49:C, 50:C, 51:C, 52:C

USFS Ecomap Regions: 222H:CC, 222Ja:CCC, 222Jb:CCC, 222Jc:CCC, 222Je:CCC, 222Jg:CCC, 222Jh:CCC, 222Ji:CCC, 222K:CC, 222L:CC, 222M:CC, 222Ua:CCC, 222Ue:CCC, 223G:CC, 251B:CC, 251C:CC, 251D:CC, 251H:CC

CONCEPT

Associations:

- *Quercus alba* - (*Quercus velutina*) - *Carya ovata* / *Ostrya virginiana* Forest (CEGL002011, G3)
- *Quercus bicolor* - (*Quercus macrocarpa*, *Quercus stellata*) Woodland (CEGL005181, G1)
- *Quercus alba* - *Quercus rubra* - *Carya ovata* Glaciated Forest (CEGL002068, G4?)
- *Quercus rubra* - *Quercus alba* - (*Quercus velutina*, *Acer rubrum*) / *Viburnum acerifolium* Forest (CEGL002462, GNR)
- *Quercus alba* - (*Carya ovata*) / *Carex pensylvanica* Glaciated Woodland (CEGL002134, G1Q)
- *Quercus macrocarpa* / *Andropogon gerardii* - *Panicum virgatum* Woodland (CEGL002052, G1G2)
- *Quercus macrocarpa* / *Corylus americana* - *Amelanchier alnifolia* Woodland (CEGL000556, G3)
- *Quercus macrocarpa* / *Cornus drummondii* / *Aralia nudicaulis* Forest (CEGL002072, G4)
- *Quercus alba* - *Quercus macrocarpa* - *Quercus rubra* / *Corylus americana* Woodland (CEGL002142, G3G4)
- *Quercus alba* - *Quercus rubra* - *Acer saccharum* - *Carya cordiformis* / *Lindera benzoin* Forest (CEGL002058, G3?)
- *Acer saccharum* - *Quercus muehlenbergii* Forest (CEGL005010, GNR)

High-ranked species: *Anisota manitobensis* (G1G2Q), *Crataegus distincta* (G1?Q), *Dichagyris reliqua* (G2G3), *Rubus variispinus* (G1?Q)

Environment: This system can occur on uplands within the prairie matrix and near floodplains, or on rolling glacial moraines and among kettle-kame topography. Soils are typically well-drained Mollisols or Alfisols that range from loamy to sandy loam in texture. Historically, this type was quite extensive in Michigan, Indiana, Illinois, Missouri, Iowa, Wisconsin, and Minnesota. Well over 700,000 hectares likely occurred in southern Michigan alone (ca. 1800). It is distinguished from other forested systems within the region by a dry-mesic edaphic condition that is transitional between dry oak forests and woodlands and mesic hardwood forests, such as maple-basswood forests.

Vegetation: Forest cover can range from a dense to moderately open canopy and there is commonly a dense shrub layer. Fire-resistant oak species, in particular *Quercus macrocarpa*, *Quercus rubra*, and/or *Quercus alba*, dominate the overstory. *Carya* spp., including *Carya ovata*, *Carya cordiformis*, and *Carya alba* (= *Carya tomentosa*), are diagnostic in portions of the range of this system. Depending on site location and overstory canopy density, the understory may include species such as *Corylus americana*, *Amelanchier* spp., *Maianthemum stellatum*, *Caulophyllum thalictroides*, *Laportea canadensis*, *Trillium grandiflorum*, *Aralia nudicaulis*, and *Urtica dioica*. Occasionally, prairie grasses such as *Andropogon gerardii* and *Panicum virgatum* may be present. Fire suppression likely has allowed for other associates, such as *Acer saccharum*, *Celtis occidentalis*, *Liriodendron tulipifera*, *Ostrya virginiana*, and *Juglans nigra*, to become more prevalent, especially in upland areas along floodplains.

Dynamics: Fire constitutes the main natural process for this type and likely maintained a more open canopy structure to support oak regeneration. Historic fire frequency was likely highest in the prairie-forest border areas. Fire suppression may account for the more closed oak forest examples of this system with the more mesic understory. It likely has allowed for other associates, such as *Acer saccharum*, *Celtis occidentalis*, *Liriodendron tulipifera*, *Ostrya virginiana*, and *Juglans nigra*, to become more prevalent, especially in upland areas along floodplains. Periodic drought, intensified by local conditions like slope, southern exposure, or sandy soil, also

inhibit growth of mesophytic trees. Extensive conversion for agriculture has fragmented these systems. Continued fire suppression has also resulted in succession to mesic hardwoods, such that in many locations, no oak species are regenerating. Remaining large areas of this system are likely under considerable pressure due to conversion to agriculture, pastureland, and urban development.

SOURCES

References: Abrams 1992, Archambault et al. 1989, Archambault et al. 1990, Comer and Albert 1997, Comer et al. 1995a, Comer et al. 2003, Eyre 1980, MNNHP 1993, Rolfmeier and Steinauer 2010

Version: 18 Jul 2006

Concept Author: P. Comer, K. Kindscher, S. Menard, D. Faber-Langendoen

Stakeholders: Midwest, Southeast

LeadResp: Midwest

M014. NORTHERN MESIC HARDWOOD & CONIFER FOREST

G629. Sub-Boreal Mesic Fir - Yellow Birch - Hardwoods Forest

CES103.434 SUB-BOREAL MESIC FIR-YELLOW BIRCH-HARDWOOD FOREST

Primary Division: Boreal (103)

Land Cover Class: Forest and Woodland

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Concept Summary: These sub-boreal conifer - northern hardwood forests are found in the eastern cool temperate forest region, ranging from north-central Minnesota, Wisconsin and Michigan through central Ontario to eastern Canada. Stands are dominated by *Picea glauca* and *Abies balsamea* with an abundance of northern hardwoods, such as *Acer rubrum*, *Acer saccharum*, *Betula alleghaniensis*, *Populus grandidentata*, *Prunus serotina*, and *Tilia americana*, along with the boreal hardwoods *Populus tremuloides* and *Betula papyrifera*. Other conifers include *Pinus strobus*, *Thuja occidentalis* and, less commonly, *Tsuga canadensis*. The shrub and herb layers are variable, decreasing as the percent conifer cover increases. Common shrub species include *Acer spicatum*, *Amelanchier* spp., *Corylus cornuta*, *Diervilla lonicera*, *Lonicera canadensis*, and *Prunus virginiana*. The moss layer ranges from discontinuous to continuous. These upland forests typically occur on mesic to wet-mesic (moist) sites, most commonly level, clayey sites, and sites with high local water tables on glacial lake deposits, stagnation moraines and till plains. Wetter sites may contain *Alnus incana* ssp. *rugosa*, *Calamagrostis canadensis*, and *Equisetum* spp.

Comments: The transition zone from the hemi- or southern boreal region to the cool temperate forest (where *Acer saccharum* is the dominant tree species) is diffuse, and relates to the increasing abundance of northern hardwood tree species and more cool temperate shrubs and herbs. Where the boreal conifers occur with a strong representation of northern hardwood species, as with this type, they are placed in I.B.2 Cool Temperate Forest Formation (F008). In Minnesota, this group is best crosswalked to MHn44: Northern Wet-Mesic Boreal Hardwood-Conifer Forest, especially MHn44b: White Pine-White Spruce - Paper Birch, MHn44c: Aspen-Fir Forest, and MHn44d: Aspen-Birch - Fir Forest (MN DNR 2003, 2005a). A stand summary table is available for Minnesota in Minnesota DNR (2005a). This group (G629) could be treated as an alliance within Northern Appalachian & Acadian Red Spruce - Fir - Hardwoods Forest Group (G024) (eastern part of range) or within Northern Hemlock - White Pine - Hardwoods Forest Group (G163). In Quebec, this type may most strongly be found in the "Balsam Fir-yellow birch domain," which also includes red spruce. Review across eastern Canada is needed to resolve hierarchy level issues.

DISTRIBUTION

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

Nations: CA, US

Subnations: MI, MN, ON, WI

CONCEPT

Associations:

SOURCES

References: Albert and Comer 2008, Comer et al. 2003, Curtis 1959, Eyre 1980, Faber-Langendoen et al. 2013, Heinselman 1996, Kost et al. 2007, Minnesota DNR 2003, Minnesota DNR 2005a, NatureServe n.d., Wisconsin DNR 2009a

Stakeholders: Canada, East, Midwest

Concept Author: K. Baldwin and Canadian NVC Committee (2012), in

LeadResp: Central Faber-Langendoen et al. (2012)

G741. Northern Hemlock - White Pine Forest

CES201.563 LAURENTIAN-ACADIAN PINE-HEMLOCK-HARDWOOD FOREST

Primary Division: Laurentian-Acadian (201)

Land Cover Class: Forest and Woodland

Spatial Scale & Pattern: Matrix

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Lowland; Forest and Woodland (Treed); *Pinus* spp. - *Tsuga canadensis*

National Mapping Codes: EVT 2366; ESLF 4308; ESP 1366

Concept Summary: This north-temperate forest system ranges from the northeastern U.S. and adjacent Canada west to the Great Lakes and upper Midwest. The mesic to dry-mesic forests usually occur on low-nutrient soils at low elevations, mostly less than 610 m (2000 feet). Canopy dominants include *Pinus strobus*, *Tsuga canadensis*, and *Quercus rubra* in varying percentages. *Acer rubrum* is also quite common; *Betula lenta* may be common at the southern periphery of this system's range. *Quercus velutina* and *Quercus alba* are essentially absent from this system, being more representative of systems in the Central Interior-Appalachian Division to the south. This is a widespread, matrix forest type for the more temperate portions of this division. Gap replacement and infrequent fire are the major natural regeneration modes.

Comments: *Tsuga canadensis* is useful to separate this system from Laurentian-Acadian Northern Pine-(Oak) Forest (CES201.719), but does not always occur in this system. Hemlock draws in USFS Section 222L (Baraboo) could be considered as remnants of this system rather than an inclusion in the hardwood matrix, as they are very distinctive from the surrounding forest and have the northern representative flora. In the East, northern hardwoods other than beech, e.g., sugar maple, are rarely found in this system. This system and Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593) grade into one another in southern New York and northern Pennsylvania; the presence of *Liriodendron tulipifera* is diagnostic for the Division 202 Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593).

DISTRIBUTION

Range: New England west to the Great Lakes and northern Minnesota.

Divisions: 201:C

TNC Ecoregions: 47:C, 48:C, 60:C, 61:C, 63:C, 64:C

Nations: CA, US

Subnations: MA, ME, MI, MN, NB, NH, NS, NY, ON, PA, QC, VT, WI

Map Zones: 41:C, 50:C, 51:C, 63:C, 64:C, 65:C, 66:C

USFS Ecomap Regions: 211A:CC, 211B:CC, 211C:CC, 211D:CC, 211E:CC, 211Fa:CCC, 211Fb:CCC, 211Ff:CCC, 212Ha:CCC, 212Hb:CCC, 212Hc:CCC, 212Hd:CCC, 212He:CCC, 212Hf:CCC, 212Hg:CCC, 212Hh:CCC, 212Hi:CCC, 212Hj:CCC, 212Hk:CCC, 212Hl:CCC, 212Hm:CCC, 212J:CC, 212K:CC, 212L:CC, 212M:CC, 212N:CC, 212Ra:CCC, 212Rb:CCC, 212Rc:CCC, 212Rd:CCC, 212Re:CCC, 212S:CC, 212T:CC, 212X:CC, 212Y:CC, 212Z:CC, 221A:CCC, 222Ja:CCC, 222Jf:CCC, 222L:CC, 222Ud:CC?, 222Ue:CCC, M211A:CC, M211B:CC, M211C:CC, M211D:CC

CONCEPT

Associations:

- *Pinus strobus* - *Tsuga canadensis* - *Picea rubens* Forest (CEGL006324, GNR)
- *Tsuga canadensis* - *Fagus grandifolia* - *Quercus rubra* Forest (CEGL006088, G4G5)
- *Quercus rubra* - *Acer rubrum* - *Betula* spp. - *Pinus strobus* Semi-natural Forest (CEGL006506, GNA)
- *Pinus strobus* - *Quercus alba* / (*Corylus americana*, *Gaylussacia baccata*) Forest (CEGL002481, G3)
- *Quercus rubra* - *Quercus alba* - (*Quercus velutina*, *Acer rubrum*) / *Viburnum acerifolium* Forest (CEGL002462, GNR)
- *Betula alleghaniensis* - *Acer rubrum* - (*Tsuga canadensis*, *Abies balsamea*) / *Osmunda cinnamomea* Forest (CEGL006380, G4?)
- *Acer saccharum* - *Pinus strobus* / *Acer pensylvanicum* Forest (CEGL005005, GNR)
- (*Pinus strobus*, *Quercus rubra*) / *Danthonia spicata* Acidic Bedrock Wooded Herbaceous Vegetation (CEGL005101, G3G4)
- *Pinus strobus* / *Acer spicatum* - *Corylus cornuta* Forest (CEGL002445, G3G4)
- *Quercus rubra* - *Acer saccharum* - *Fagus grandifolia* / *Viburnum acerifolium* Forest (CEGL006173, G4G5)
- *Tsuga canadensis* - (*Betula alleghaniensis*) - *Picea rubens* / *Cornus canadensis* Forest (CEGL006129, GNR)
- *Tsuga canadensis* - (*Betula alleghaniensis*) Forest (CEGL002598, G3?)
- *Pinus strobus* - *Quercus* (*rubra*, *velutina*) - *Fagus grandifolia* Forest (CEGL006293, G5)
- *Acer rubrum* - *Nyssa sylvatica* - *Betula alleghaniensis* / *Sphagnum* spp. Forest (CEGL006014, G3)
- *Tsuga canadensis* - *Fagus grandifolia* - *Acer saccharum* / (*Hamamelis virginiana*, *Kalmia latifolia*) Forest (CEGL005043, G3?)
- *Pinus strobus* - *Tsuga canadensis* Great Lakes Forest (CEGL002590, G3)
- *Tsuga canadensis* - *Acer saccharum* - *Betula alleghaniensis* Forest (CEGL005044, G4?)
- *Pinus strobus* - (*Pinus resinosa*) - *Quercus rubra* Forest (CEGL002480, G4)
- *Thuja occidentalis* - (*Betula alleghaniensis*, *Tsuga canadensis*) Forest (CEGL002595, G3?)
- *Tsuga canadensis* - *Fagus grandifolia* - (*Acer saccharum*) Great Lakes Forest (CEGL005042, G4G5)
- *Quercus rubra* - *Acer saccharum* - (*Betula alleghaniensis*) Forest (CEGL002461, G4G5)
- *Symplocarpus foetidus* Herbaceous Vegetation (CEGL002385, G4?)

High-ranked species: *Mimulus glabratus* var. *michiganensis* (G5T1), *Myotis sodalis* (G2), *Nicrophorus americanus* (G2G3), *Rubus vagus* (G2?Q)

SOURCES

References: Comer and Albert 1997, Comer et al. 1995a, Comer et al. 1998, Comer et al. 2003, Eyre 1980, Gawler and Cutko 2010, Whitney 1984

Version: 20 Aug 2007

Stakeholders: Canada, East, Midwest

CES202.704 PALEOZOIC PLATEAU BLUFF AND TALUS**Primary Division:** Central Interior and Appalachian (202)**Land Cover Class:** Steppe/Savanna**Spatial Scale & Pattern:** Small patch**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Upland**National Mapping Codes:** EVT 2517; ESLF 5430; ESP 1517

Concept Summary: This system is found in the driftless regions of southeastern Minnesota, southwestern Wisconsin, and northern Iowa and Illinois. This region was not glaciated like the surrounding areas and thus is predominated by rolling hills and bluff outcrops. This system is found primarily on bluffs and dry upper slopes along the Upper Mississippi River, although it can range into bordering regions such as the Baraboo Hills in Wisconsin. This system contains a mosaic of woodlands, savannas, prairies and sparsely vegetated limestone, dolomite, and/or sandstone outcrops, with occasional talus, especially algific talus. Soils range from thin to moderately deep and are moderately to excessively well-drained with a high mineral content. Woodlands consist of primarily a mixture of oak species such as *Quercus macrocarpa*, *Quercus rubra*, *Quercus muehlenbergii*, and *Quercus alba*. *Acer saccharum*, *Betula alleghaniensis*, and conifer species such as *Pinus* spp. and *Tsuga canadensis* may occur on more mesic and protected areas within this system. Prairie openings (also called "goat prairies") contain *Schizachyrium scoparium* and *Bouteloua curtipendula* with scattered *Juniperus virginiana*. Historically, fire was the most important dynamic maintaining these systems, however, fire suppression within the region has allowed more canopy cover and thus very few prairie openings remain. Algific talus harbors a number of unusual Pleistocene relict species, including plants and snails.

Comments: This system will need review from Minnesota, Wisconsin and Iowa to make sure it is correctly characterized.

DISTRIBUTION

Range: This system is found within the Paleozoic Plateau (aka Driftless Region) of southeastern Minnesota, southwestern Wisconsin and northern Iowa and Illinois.

Divisions: 202:C**TNC Ecoregions:** 46:C**Nations:** US**Subnations:** IA, IL, MN, WI**Map Zones:** 42:C, 49:C, 50:C**USFS Ecomap Regions:** 222L:CC**CONCEPT****Associations:**

- *Tsuga canadensis* - *Acer saccharum* / (*Hepatica nobilis* var. *acuta*) Driftless Forest (CEGL002597, G2)
- *Schizachyrium scoparium* - *Bouteloua curtipendula* - *Muhlenbergia cuspidata* - *Symphotrichum sericeum* Alkaline Herbaceous Vegetation (CEGL002403, G2)
- *Schizachyrium scoparium* - *Bouteloua curtipendula* Bedrock Bluff Herbaceous Vegetation (CEGL002245, G3G4)
- *Pinus strobus* - (*Pinus resinosa*) Driftless Bluff Forest (CEGL002378, G2G3)
- *Pinus strobus* - *Abies balsamea* - *Betula alleghaniensis* Driftless Forest (CEGL002111, G2?)
- *Impatiens pallida* - *Cystopteris bulbifera* - *Adoxa moschatellina* - (*Chrysosplenium iowense*, *Aconitum noveboracense*) Herbaceous Vegetation (CEGL002387, G2)
- Maderate Cliff Sparse Vegetation (CEGL002293, G3?)
- *Quercus muehlenbergii* - *Quercus (alba, velutina)* - (*Juniperus virginiana* var. *virginiana*) Bluff Woodland (CEGL002144, G2G3)

SOURCES**References:** Albert 1995b, Comer et al. 2003, Dunevitz pers. comm., Eyre 1980**Version:** 05 Mar 2003**Concept Author:** S. Menard**Stakeholders:** Midwest**LeadResp:** Midwest**G742. Southern & Central Appalachian Northern Hardwoods - Hemlock Forest****CES202.593 APPALACHIAN (HEMLOCK)-NORTHERN HARDWOOD FOREST****Primary Division:** Central Interior and Appalachian (202)**Land Cover Class:** Forest and Woodland**Spatial Scale & Pattern:** Matrix**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Upland**Diagnostic Classifiers:** Mesotrophic Soil; Needle-Leaved Tree; Broad-Leaved Deciduous Tree; *Pinus* spp. - *Tsuga canadensis***National Mapping Codes:** EVT 2370; ESLF 4313; ESP 1370

Concept Summary: This forested system of the northeastern U.S. ranges from central New England west to Lake Erie and south to the higher elevations of Virginia and West Virginia. It is one of the matrix forest types in the northern part of the Central Interior and Appalachian Division. Northern hardwoods such as *Acer saccharum*, *Betula alleghaniensis*, and *Fagus grandifolia* are characteristic, either forming a deciduous canopy or mixed with *Tsuga canadensis* (or in some cases *Pinus strobus*). Other common and sometimes dominant trees include *Quercus* spp. (most commonly *Quercus rubra*), *Liriodendron tulipifera*, *Prunus serotina*, and *Betula lenta*. It is of more limited extent and more ecologically constrained in the southern part of its range, in northern parts of Virginia and West Virginia.

Comments: Northward this system is replaced by Laurentian-Acadian Pine-Hemlock-Hardwood Forest (CES201.563) and Laurentian-Acadian Northern Hardwood Forest (CES201.564), but the systems overlap on the Allegheny Plateau and in central New England. USFS ecological province lines provide a general delimiter, with areas in Provinces 211 and M211 mostly falling into the Laurentian-Acadian systems, and areas in Provinces 221 and M221 falling into this Appalachian system. The range of *Liriodendron tulipifera* is a good approximator for the northern limit of this system's range.

DISTRIBUTION

Range: This system is found from central New England south to Virginia and West Virginia and probably in adjacent Kentucky.

Divisions: 202:C

TNC Ecoregions: 48:C, 49:C, 52:?, 59:C, 60:C, 61:C

Nations: US

Subnations: CT, KY?, MA, MD, ME?, NH, NJ, NY, OH?, PA, VA, VT, WV

Map Zones: 53:C, 60:C, 61:C, 62:C, 63:C, 64:C, 65:C, 66:C

USFS Ecomap Regions: 211E:CC, 211Fc:CCC, 211Fd:CCC, 211G:CC, 221Aa:CCC, 221B:CC, 221D:CC, 221E:CC, 221F:CC, 222I:CC, M221A:CC, M221B:CC, M221C:CC, M221D:CC

CONCEPT

Associations:

- *Acer saccharum* - *Quercus rubra* / *Hepatica nobilis* var. *obtusata* Forest (CEGL006046, GNR)
- *Tsuga canadensis* - *Fagus grandifolia* - *Quercus rubra* Forest (CEGL006088, G4G5)
- *Chrysosplenium americanum* Herbaceous Vegetation (CEGL006193, G3G5)
- *Quercus rubra* - *Tsuga canadensis* - *Liriodendron tulipifera* / *Hamamelis virginiana* Forest (CEGL006566, G4?)
- *Tsuga canadensis* - *Betula alleghaniensis* - *Prunus serotina* / *Rhododendron maximum* Forest (CEGL006206, G4?)
- *Acer saccharum* - *Betula alleghaniensis* - *Fagus grandifolia* / *Viburnum lantanoides* Forest (CEGL006252, G5)
- *Acer saccharum* - *Pinus strobus* / *Acer pensylvanicum* Forest (CEGL005005, GNR)
- *Quercus rubra* - *Acer saccharum* - *Fagus grandifolia* / *Viburnum acerifolium* Forest (CEGL006173, G4G5)
- *Acer saccharum* - *Betula alleghaniensis* - *Prunus serotina* Forest (CEGL006045, G4)
- *Acer saccharum* - *Fraxinus americana* - *Juglans cinerea* / *Staphylea trifolia* / *Adlumia fungosa* Forest (CEGL006577, GNR)
- *Carex scabrata* - *Viola cucullata* / *Plagiomnium ciliare* Herbaceous Vegetation (CEGL006597, G3)
- *Tsuga canadensis* - *Fagus grandifolia* - *Quercus* (*prinus*, *alba*) Forest (CEGL006474, G2G3)
- *Tsuga canadensis* - *Betula alleghaniensis* - *Acer saccharum* / *Dryopteris intermedia* Forest (CEGL006109, G4?)
- *Tsuga canadensis* - (*Betula alleghaniensis*, *Quercus rubra*) / *Ilex montana* / *Rhododendron catawbiense* Forest (CEGL008513, G1?)
- *Quercus* (*rubra*, *velutina*, *alba*) - *Betula lenta* - (*Pinus strobus*) Forest (CEGL006454, G4G5)
- *Rhododendron maximum* Upland Shrubland (CEGL003819, G3?Q)
- *Quercus rubra* - *Acer saccharum* - *Liriodendron tulipifera* Forest (CEGL006125, G4?)
- *Tsuga canadensis* - *Fagus grandifolia* - *Acer saccharum* / (*Hamamelis virginiana*, *Kalmia latifolia*) Forest (CEGL005043, G3?)
- *Tsuga canadensis* - *Betula alleghaniensis* / *Veratrum viride* - *Carex scabrata* - *Oclemena acuminata* Forest (CEGL008533, G2)
- *Pinus strobus* - *Tsuga canadensis* Lower New England / Northern Piedmont Forest (CEGL006328, G5)
- *Thuja occidentalis* - *Pinus strobus* - *Tsuga canadensis* / *Carex eburnea* Woodland (CEGL008426, G1G2)
- *Pinus strobus* - *Tsuga canadensis* / *Acer pensylvanicum* / *Polystichum acrostichoides* Forest (CEGL006019, G4?)
- *Quercus bicolor* / *Vaccinium corymbosum* / *Carex stipata* Forest (CEGL006241, GNR)
- *Picea rubens* - *Tsuga canadensis* - *Fagus grandifolia* / *Dryopteris intermedia* Forest (CEGL006029, G3)
- *Fagus grandifolia* - *Betula lenta* - *Liriodendron tulipifera* - *Acer saccharum* Forest (CEGL006296, GNR)
- *Betula alleghaniensis* - (*Tsuga canadensis*) / *Rhododendron maximum* / (*Leucothoe fontanesiana*) Forest (CEGL007861, G3)
- *Acer saccharum* - (*Fraxinus americana*) / *Arisaema triphyllum* Forest (CEGL006211, G4)
- *Betula alleghaniensis* - *Quercus rubra* / *Acer* (*pensylvanicum*, *spicatum*) / *Dryopteris intermedia* - *Oclemena acuminata* Forest (CEGL008502, G3G4)
- *Betula alleghaniensis* / *Sorbus americana* - *Acer spicatum* / *Polypodium appalachianum* Forest (CEGL008504, G2)

High-ranked species: *Aneides aeneus* (G3G4), *Bryocromia vivicolor* (G1G2), *Buckleya distichophylla* (G3), *Canis rufus* (G1Q), *Carex brysonii* (G1), *Catocala marmorata* (G3G4), *Cephaloziella spinicaulis* (G3G4), *Cheilolejeunea evansii* (G1G2), *Clematis addisonii* (G1?), *Desmognathus wrightii* (G3), *Diplophyllum obtusatum* (G2?), *Drepanolejeunea appalachiana* (G2?), *Fissidens appalachensis* (G2G3), *Frullania appalachiana* (G1?), *Hexastylis contracta* (G3), *Homaliadelphus sharpii* (G3?), *Hymenophyllum tayloriae* (G2), *Lejeunea blomquistii* (G1G2), *Lophocolea appalachiana* (G1G2Q), *Marsupella emarginata* var. *latiloba* (G5T1T2),

Metzgeria fruticulosa (G2Q), *Microtus chrotorrhinus carolinensis* (G4T3), *Nardia lescurii* (G3?), *Neotoma magister* (G3G4), *Plagiochila austinii* (G3), *Plagiochila caduciloba* (G2), *Plagiochila sullivantii* var. *spinigera* (G2T1), *Plagiochila sullivantii* var. *sullivantii* (G2T2), *Plagiochila virginica* var. *caroliniana* (G3T2), *Platyhypnidium pringlei* (G2G3), *Plethodon aureolus* (G2G3), *Plethodon hubrichti* (G2), *Plethodon punctatus* (G3), *Plethodon welleri* (G3), *Puma concolor cougar* (G5THQ), *Riccardia jugata* (G2), *Schlotheimia lancifolia* (G2), *Shortia galacifolia* var. *brevistyla* (G2G3T2), *Shortia galacifolia* var. *galacifolia* (G2G3T2T3), *Sorex palustris punctulatus* (G5T3), *Styobromus* sp. 17 (G2), *Tetradontium brownianum* (G3G4), *Trillium persistens* (G1), *Triphora trianthophora* (G3G4), *Tsuga caroliniana* (G3), *Virginia valeriana pulchra* (G5T3T4)

Environment: This system occurs predominantly on mesic sites over a broad range of topographic conditions, such as protected low and midslopes and valley bottoms, at elevations from 305 to 915 m (1000-3000 feet). Soils are usually acidic and retain some moisture except during severe droughts. They are moderately well-drained to well-drained loamy or silty soils, and are rocky and usually deep in depressions among boulders. In riparian areas, it is usually along high-gradient (1-2%) streams. In the Central Appalachian center of its range, its ecological amplitude is somewhat broader, and it approaches matrix forest in some areas. At Shenandoah National Park, this system spans a broad range of environmental settings from steep west-facing slopes to south-facing gentle slopes.

Vegetation: The canopy is characterized and often usually dominated by northern hardwoods (e.g., *Fagus grandifolia* and *Acer saccharum*), often with *Tsuga canadensis*, but may also contain large amounts of *Pinus strobus* and *Quercus* spp. *Tsuga canadensis* can dominate the canopy on cool/moist sites at higher elevations and in shaded coves, valley bottoms and riparian areas. Bottomlands and toeslopes may also contain *Fraxinus americana*, as well as *Platanus occidentalis* (Whitney 1990). Other common associates may include *Acer rubrum*, *Prunus serotina*, *Betula lenta*, *Tilia americana*, *Pinus strobus*, *Liriodendron tulipifera*, *Quercus* spp., and *Magnolia acuminata*. The subcanopy and shrub layers are usually well-developed and may include *Viburnum lantanoides* (= *Viburnum alnifolium*), *Viburnum acerifolium*, *Hamamelis virginiana*, and *Cornus alternifolia*. A dense, low to high shrub layer of *Rhododendron maximum* and sometimes *Kalmia latifolia* is sometimes present. Common herbaceous species include *Maianthemum canadense*, *Onoclea sensibilis*, *Huperzia lucidula* (= *Lycopodium lucidulum*), *Dryopteris carthusiana* (= *Dryopteris spinulosa*), *Oxalis montana*, and *Mitchella repens* (Lutz 1930, Braun 1950).

Dynamics: In general, this system is dominated by long-lived, mesic species that form multi-layered uneven-aged forests. Canopy dynamics are dominated by single and multiple disturbances encouraging gap phase regeneration (Abrams and Orwig 1996). Larger disturbances include windthrow, insect attack and ice storms. Although stand-replacing wind events are rare, small to medium blowdown events are more common and occur at greater frequency on the plateau and exposed sideslopes (Ruffner and Abrams 2003). This system is currently being devastated in large parts of its range by the hemlock woolly adelgid (*Adelges tsugae*). This sucking insect is continuing to cause close to 100% mortality as it spreads from the north into the southern United States. The insect will most likely cause canopy hemlocks to be replaced by other canopy trees. Historically, this system was probably only subject to occasional fires. Fires that did occur may have been catastrophic and may have led to even-aged stands of pine and hemlock. Fire suppression appears to have increased the extent of this system at the expense of oak-pine systems.

SOURCES

References: Abrams and Orwig 1996, Braun 1950, Comer et al. 2003, Eyre 1980, Fleming et al. 2005, Gawler and Cutko 2010, LNVDD 2007, Litvaitis 2003, Lorimer and Frelich 1994, Lutz 1930, Ruffner and Abrams 2003, Runkle 1982, Whitney 1990, Yahn pers. comm.

Version: 23 Jan 2012

Stakeholders: East, Midwest, Southeast

Concept Author: S.C. Gawler, R. White, R. Evans, M. Pyne

LeadResp: East

G743. Northern Hardwoods Forest

CES201.564 LAURENTIAN-ACADIAN NORTHERN HARDWOOD FOREST

Primary Division: Laurentian-Acadian (201)

Land Cover Class: Forest and Woodland

Spatial Scale & Pattern: Matrix

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Montane; Forest and Woodland (Treed); Eutrophic Soil; Mesotrophic Soil; Broad-Leaved Tree; *Acer saccharum* - *Betula* spp.

National Mapping Codes: EVT 2302; ESLF 4108; ESP 1302

Concept Summary: These northern hardwood forests range across New England and adjacent Canada, south to northern Pennsylvania and west to Minnesota. They occur in various dry-mesic to wet-mesic settings at low to moderate elevations (generally <610 m [2000 feet]) throughout the Laurentian-Acadian Division. *Acer saccharum*, *Betula alleghaniensis*, and *Fagus grandifolia* are the dominant trees (the latter only east of northern Wisconsin). *Tsuga canadensis* or, in the Northeast, *Picea rubens* are common minor canopy associates. *Ostrya virginiana* is frequent but not dominant. Oak is a minor component and absent from northern regions. Successional stands may be dominated by *Populus tremuloides*, *Betula papyrifera*, *Acer rubrum*, *Fraxinus americana*, *Prunus serotina*, sometimes with scattered *Pinus strobus*. Soils range from moderately nutrient-poor to quite enriched, with associated shifts in the herb flora. This system can include large expanses of rich forest in areas of limestone or similar bedrock, as

well as forests that are relatively poor floristically in areas of granitic (or similar) bedrock or acidic till. Blowdowns or snow and ice loading, with subsequent gap regeneration, are the most frequent form of natural disturbance.

Comments: An east-west separation between the Laurentian and Acadian regions was considered, but the hardwoods component is essentially similar (though beech drops out in the most western part of this system). It appears to be more of a gradient, with beech and hobblebush dropping out and fire frequency probably a little greater in the western portion. A possible split at Lake Michigan could be considered if one could make a better case than just beech. Hemlock-hardwood inclusions in the East may be part of this system where the matrix and surroundings are predominantly hardwood, but where hemlock and pine are prevalent, as in ravines or cool slopes, Laurentian-Acadian Pine-Hemlock-Hardwood Forest (CES201.563) is the appropriate system.

DISTRIBUTION

Range: This system occurs in northern New England and northern New York west across the upper Great Lakes to northern Minnesota, and adjacent Canada; occasional southwards.

Divisions: 201:C, 202:C

TNC Ecoregions: 47:C, 48:C, 60:C, 61:C, 63:C, 64:C

Nations: CA, US

Subnations: MA, ME, MI, MN, NB, NH, NS, NY, ON, PA, QC, VT, WI

Map Zones: 41:C, 50:C, 51:C, 63:C, 64:C, 65:C, 66:C

USFS Ecomap Regions: 211A:CC, 211B:CC, 211C:CC, 211D:CC, 211E:CC, 211F:CC, 211I:CC, 211J:CC, 212Ha:CCC, 212Hb:CCC, 212Hc:CCC, 212Hd:CCC, 212He:CCC, 212Hf:CCC, 212Hg:CCC, 212Hh:CCC, 212Hi:CCC, 212Hj:CCC, 212Hk:CCC, 212Hl:CCC, 212Hm:CCC, 212J:CC, 212K:CC, 212L:CC, 212M:CC, 212N:CC, 212Q:CC, 212Ra:CCC, 212Rb:CCC, 212Rc:CCC, 212Rd:CCC, 212Re:CCC, 212S:CC, 212T:CC, 212X:CC, 212Y:CC, 212Z:CC, 221B:CC, 222I:CC, 222Ja:CCC, 222Jf:CCC, 222Ud:CCC, 222Ue:CCC, M211A:CC, M211B:CC, M211C:CC, M211D:CC

CONCEPT

Associations:

- *Betula papyrifera* / *Acer saccharum* - Mixed Hardwoods Forest (CEGL002464, G4?)
- *Acer saccharum* - *Fraxinus americana* - *Tilia americana* / *Acer spicatum* / *Caulophyllum thalictroides* Forest (CEGL005008, G4?)
- *Acer saccharum* - (*Fraxinus americana*) / *Arisaema triphyllum* Forest (CEGL006211, G4)
- *Acer saccharum* - *Tilia americana* / *Ostrya virginiana* / *Lonicera canadensis* Forest (CEGL002458, G3?)
- *Populus tremuloides* - *Betula papyrifera* - (*Acer rubrum*, *Populus grandidentata*) Forest (CEGL002467, G5)
- *Onoclea sensibilis* - (*Adiantum pedatum*) - *Impatiens capensis* - *Carex plantaginea* Herbaceous Vegetation (CEGL006409, G4?)
- *Acer saccharum* - *Betula alleghaniensis* - *Fagus grandifolia* / *Viburnum lantanoides* Forest (CEGL006252, G5)
- *Tsuga canadensis* - (*Betula alleghaniensis*) - *Picea rubens* / *Cornus canadensis* Forest (CEGL006129, GNR)
- *Acer saccharum* - *Fagus grandifolia* - *Betula* spp. / *Maianthemum canadense* Forest (CEGL005004, G4G5)
- *Thuja occidentalis* - *Betula alleghaniensis* Forest (CEGL002450, G2Q)
- *Thuja occidentalis* / *Abies balsamea* - *Acer spicatum* Forest (CEGL002449, G4)
- *Acer saccharum* - *Betula alleghaniensis* - (*Tilia americana*) Forest (CEGL002457, G3G4)
- *Populus* (*tremuloides*, *grandidentata*) - *Betula* (*populifolia*, *papyrifera*) Semi-natural Woodland (CEGL006303, G5)
- *Symplocarpus foetidus* Herbaceous Vegetation (CEGL002385, G4?)
- Boreal Glaciere Talus Sparse Vegetation (CEGL005243, G2G3)

High-ranked species: *Botrychium lineare* (G2G3), *Botrychium* sp. 3 (G3), *Catinella gelida* (G1), *Frullania selwyniana* (G2G3), *Mimulus glabratus* var. *michiganensis* (G5T1), *Myotis sodalis* (G2), *Nicrophorus americanus* (G2G3), *Ophiogomphus smithi* (G2G3), *Rubus variispinus* (G1?Q), *Schoenoplectus hallii* (G2G3), *Stenelmis douglasensis* (G1G3)

SOURCES

References: Comer and Albert 1997, Comer et al. 1995a, Comer et al. 1998, Comer et al. 2003, Eyre 1980, Gawler and Cutko 2010

Version: 04 Feb 2009

Stakeholders: Canada, East, Midwest

Concept Author: S.C. Gawler

LeadResp: East

M016. SOUTH-CENTRAL OAK - HARDWOOD & PINE FOREST

G012. Shortleaf Pine - Oak Forest

CES202.325 OZARK-OUACHITA SHORTLEAF PINE-BLUESTEM WOODLAND

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Forest and Woodland

Spatial Scale & Pattern: Matrix

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Forest and Woodland (Treed); Very Short Disturbance Interval; Needle-Leaved Tree; Ozark/Ouachita

National Mapping Codes: EVT 2507; ESLF 4281; ESP 1507

Concept Summary: This system represents woodlands of the Ouachita and Ozark mountains region of Arkansas, adjacent Oklahoma, and southern Missouri in which *Pinus echinata* is the canopy dominant, and the understory is characterized by *Andropogon gerardii*, *Schizachyrium scoparium*, and other prairie elements. Although examples of this system occur throughout this region, there is local variation in the extent to which they were present. For example, this system was historically prominent in the Ozark Highlands where sandstone derived soils were common, being excluded from or diminished in other areas by inadequate winter precipitation and non-conducive soils. In Missouri and Oklahoma, this system occurs on gently dissected upland cherty plains (in addition to sandstone ridges). The center of distribution would be the northern and western Ouachita Mountains. In the Ouachitas, the system occurs on the northern Hogback Ridges excluding the Novaculite areas to the south. In nearly all cases, *Pinus echinata* occurs with a variable mixture of hardwood species. The exact composition of the hardwoods is much more closely related to aspect and topographic factors than is the pine component.

Comments: This system is primarily confined to gently to moderately sloping, upland plains and is distinguished from Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland (CES202.313), which occurs on more steeply dissected ridges and steep southwest-facing slopes. The abundance of prairie flora also distinguishes this system from the shortleaf pine-oak woodland.

DISTRIBUTION

Range: This system occurs in the Ouachita and Ozark mountains region of Arkansas, adjacent Oklahoma, and southern Missouri.

Divisions: 202:C

TNC Ecoregions: 38:C, 39:C

Nations: US

Subnations: AR, MO, OK

Map Zones: 44:C

USFS Ecomap Regions: 223A:CC, M223A:CC, M231A:CC

CONCEPT

Associations:

- *Pinus echinata* / Rock Outcrop Interior Highland Woodland (CEGL002402, G2G3)
- *Pinus echinata* - *Quercus alba* / *Schizachyrium scoparium* Woodland (CEGL002394, G3G4)
- *Pinus echinata* - *Quercus stellata* - *Quercus marilandica* / *Schizachyrium scoparium* Woodland (CEGL002393, G2G3)
- *Pinus echinata* / *Schizachyrium scoparium* - *Solidago ulmifolia* - *Monarda russeliana* - *Echinacea pallida* Woodland (CEGL007815, G1G2)

Environment: This system was historically prominent in the Ozark Highlands where sandstone derived soils were common, being excluded from or diminished in other areas by inadequate winter precipitation and non-conducive soils. In Missouri and Oklahoma, this system occurs on gently dissected upland cherty plains (in addition to sandstone ridges). This system is primarily confined to gently to moderately sloping, upland plains and is distinguished from shortleaf pine-oak woodland, which occurs on more steeply dissected ridges and steep southwest-facing slopes. In the Ouachitas, the system occurs on the northern Hogback Ridges excluding the Novaculite areas to the south.

Vegetation: In the northern part of this geographic area *Pinus echinata*, xeric oaks and some hickory dominate the overstory with a high percentage of oak on steep north slopes and on *Quercus stellata* flats. Associated species include *Quercus marilandica* and *Carya alba* on drier sites and to the west *Carya texana*. In some examples of this system, the aggregate importance of hardwoods may be greater than pine, especially on subxeric and mesic sites (Dale and Ware 1999). Pine is often the canopy emergent on upper slopes. Stand density increases with available moisture. Typical shrubs may include *Vaccinium arboreum*, *Vaccinium pallidum*, and *Vaccinium stamineum*, but these patches are rare. Various bluestem grasses, legumes and other forbs dominate the understory (herbaceous layer).

Dynamics: This system is fire regime group I, with frequent surface fires. Area fire frequency is 3-4 years mean fire interval (range=1-12 years) (Masters et al. 1995). Annual fire was common historically. Replacement and mixed severity fires are infrequent, every 100 to 1000 years. Stand-replacement fires occurred mostly under extreme drought conditions during the growing season. Other disturbance types include ice storms, wind events, and insect infestations. The impact of native ungulate grazing (buffalo and elk) was negligible, but fire generally maintained systems. Drought and moist cycles play a strong role interacting with both fire and native grazing.

SOURCES

References: Dale and Ware 1999, Eyre 1980, Masters et al. 1995, Southeastern Ecology Working Group n.d., USFS 1999

Version: 01 Feb 2007

Concept Author: T. Foti, R. Masters, D. Zollner

Stakeholders: Midwest, Southeast

LeadResp: Southeast

CES202.313 OZARK-OUACHITA SHORTLEAF PINE-OAK FOREST AND WOODLAND

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Forest and Woodland

Spatial Scale & Pattern: Matrix

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Forest and Woodland (Treed); Short Disturbance Interval; Needle-Leaved Tree; Ozark/Ouachita

National Mapping Codes: EVT 2367; ESLF 4310; ESP 1367

Concept Summary: This system represents forests and woodlands of the Ouachita and Ozark mountains region of Arkansas, adjacent Oklahoma, and southern Missouri in which *Pinus echinata* is an important or dominant component. Although examples of this system occur throughout this region, there is local variation in the extent to which they were present. For example, this system was historically prominent only in the southeastern part of the Ozark Highlands where sandstone derived soils were common, being excluded from or diminished in other areas by inadequate winter precipitation and non-conducive soils. In contrast, pine was virtually ubiquitous in the historical forests of the Ouachitas. In nearly all cases (at least in the Ouachitas), *Pinus echinata* occurs with a variable mixture of hardwood species. The exact composition of the hardwoods is much more closely related to aspect and topographic factors than is the pine component. In some examples of this system, the aggregate importance of hardwoods may be greater than pine, especially on subxeric and mesic sites.

Comments: This system (CES202.313) is distinguished from the equivalent Appalachian system (CES202.332) at its western extent in central Tennessee by the absence of *Pinus virginiana* and *Quercus prinus*, which do not cross the Mississippi River.

DISTRIBUTION

Range: This system occurs in the Ouachita and Ozark mountains region of Arkansas, adjacent Oklahoma, and southern Missouri.

Divisions: 202:C

TNC Ecoregions: 38:C, 39:C

Nations: US

Subnations: AR, MO, OK

Map Zones: 32:C, 44:C, 49:P

USFS Ecomap Regions: 223A:CC, 231Ee:CCC, 231Gc:CCC, M223A:CC, M231A:CC

CONCEPT

Associations:

- *Pinus echinata* - *Quercus (alba, rubra)* / *Vaccinium (arboreum, pallidum)* / *Schizachyrium scoparium* - *Chasmanthium sessiliflorum* - *Solidago ulmifolia* Forest (CEGL007489, G3G4)
- *Pinus echinata* / Rock Outcrop Interior Highland Woodland (CEGL002402, G2G3)
- *Pinus echinata* - *Quercus alba* / *Schizachyrium scoparium* Woodland (CEGL002394, G3G4)
- *Pinus echinata* - *Quercus stellata* - *Quercus marilandica* / *Schizachyrium scoparium* Woodland (CEGL002393, G2G3)
- *Pinus echinata* / *Vaccinium (arboreum, pallidum, stamineum)* Forest (CEGL002400, G3G4)
- *Pinus echinata* - *Quercus velutina* - *Quercus stellata* / *Vaccinium* spp. Forest (CEGL002401, G3)
- *Pinus echinata* - *Quercus alba* - *Quercus falcata* Forest (CEGL004444, G3?Q)
- *Pinus echinata* / *Schizachyrium scoparium* - *Solidago ulmifolia* - *Monarda russeliana* - *Echinacea pallida* Woodland (CEGL007815, G1G2)

High-ranked species: *Galium arkansanum* var. *pubiflorum* (G5T2Q), *Houstonia ouachitana* (G3), *Solidago ouachitensis* (G3), *Streptanthus squamiformis* (G2G3)

Environment: In the Ozark Highlands, this system was historically prominent only in the southeastern part, where sandstone derived soils were common (USFS 1999); being limited in other areas by inadequate winter precipitation, and non-conducive soils. In contrast, pine was "virtually ubiquitous in the historical forests of the Ouachitas" (USFS 1999). In nearly all cases (at least in the Ouachitas), *Pinus echinata* occurs with a variable mixture of hardwood species. The exact composition of the hardwoods is much more closely related to aspect and topographic factors than is the pine component (Dale and Ware 1999).

Vegetation: Stands of this system typically contain *Pinus echinata* with various oak species, including *Quercus alba*, *Quercus rubra*, *Quercus falcata*, *Quercus stellata*, *Quercus velutina*, and *Quercus marilandica*. In some examples of this system, the aggregate importance of hardwoods may be greater than pine, especially on subxeric and mesic sites (Dale and Ware 1999). Typical shrubs include *Vaccinium arboreum*, *Vaccinium pallidum*, and *Vaccinium stamineum*. Characteristic herbs include *Schizachyrium scoparium*, *Chasmanthium sessiliflorum*, *Solidago ulmifolia*, *Monarda russeliana*, and *Echinacea pallida*.

SOURCES

References: Comer et al. 2003, Dale and Ware 1999, Eyre 1980, USFS 1999

Version: 17 Apr 2006

Concept Author: T. Foti and R. Evans

Stakeholders: Midwest, Southeast

LeadResp: Southeast

CES202.332 SOUTHERN APPALACHIAN LOW-ELEVATION PINE FOREST

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Forest and Woodland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Forest and Woodland (Treed); Acidic Soil; Short Disturbance Interval; Needle-Leaved Tree

National Mapping Codes: EVT 2353; ESLF 4256; ESP 1353

Concept Summary: This system consists of shortleaf pine- and Virginia pine-dominated forests in the lower elevation Southern Appalachians and adjacent Piedmont and Cumberland Plateau, extending into the Interior Low Plateau of Indiana, Kentucky and

Tennessee. Examples can occur on a variety of topographic and landscape positions, including ridgetops, upper and midslopes, as well as lower elevations (generally below 700 m [2300 feet]) in the Southern Appalachians such as mountain valleys. Examples occur on a variety of acidic bedrock types. Frequent, low-intensity fires coupled with severe fires (Harrod and White 1999) may have been the sole factor determining the occurrence of this system rather than hardwood forests under natural conditions. Under current conditions, stands are dominated by *Pinus echinata* or *Pinus virginiana*. *Pinus rigida* may sometimes be present. Hardwoods are sometimes abundant, especially dry-site oaks such as *Quercus falcata*, *Quercus prinus*, and *Quercus coccinea*, but also *Carya glabra*, *Acer rubrum*, and others. The shrub layer may be well-developed, with *Vaccinium pallidum*, *Gaylussacia baccata*, or other acid-tolerant species most characteristic. Herbs are usually sparse but may include *Pityopsis graminifolia* and *Tephrosia virginiana*.

Comments: This system and its component associations are among the least studied in the southern Appalachians (Harrod and White 1999). Settlement, universal logging, pine beetle outbreaks, and fire suppression potentially have altered their character and blurred their boundaries more than most systems in the region. The situation is further complicated by the potential for pine-dominated forests to have been both created and destroyed in different places by these disturbances. Obviously successional pine forests associated with the recovery of heavily logged or plowed slopes and valleys are grouped into the matrix Central and Southern Appalachian Montane Oak Forest (CES202.596).

The relationship between this system and Southern Appalachian Montane Pine Forest and Woodland (CES202.331) may need further clarification. Southern Appalachian Low-Elevation Pine Forest (CES202.332) is distinguished by its occurrence as large patches on lower terrain (generally below 700 m [2300 feet]) and less extreme topography. The vegetation of the two systems may overlap due to the factors outlined above, but pitch pine and Table Mountain pine are more typical of the former, while shortleaf pine and Virginia pine are more typical of the latter.

Presently the shortleaf pine-dominated vegetation of the Interior Low Plateau (ILP), including examples in southern Indiana and the Tennessee portion of Land Between the Lakes, is included in this system. Frost (1998) treats the ILP region in a different fire-return-interval class than the core range of this system, although local variation may overwhelm the broad regional differences. If more detailed information becomes available to document important ecological differences between these areas, a new system may be required.

This system (CES202.332) at its western extent in central Tennessee and Kentucky would be distinguished from equivalent Ozarkian systems (e.g., Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland (CES202.313)) by the presence of *Pinus virginiana* and *Quercus prinus*, which do not cross the Mississippi River.

DISTRIBUTION

Range: This system is found primarily in the Appalachian regions of Kentucky and the Southern Blue Ridge in northern Georgia, western North Carolina, southeastern Tennessee, the Cumberlands of Alabama, parts of the Interior Low Plateau (e.g., the Knobs Region of Kentucky and southern Indiana and the western Highland Rim of Tennessee), and southwestern Virginia.

Divisions: 202:C

TNC Ecoregions: 44:C, 50:C, 51:C, 52:C

Nations: US

Subnations: AL, GA, IN, KY, NC, SC, TN, VA

Map Zones: 47:C, 48:C, 53:C, 54:C, 57:C, 59:C

USFS Ecomap Regions: 221H:CC, 221J:CC, 223D:CC, 223E:CC, 231A:CC, 231C:CC, 231D:CC, 231I:CC, M221A:CC, M221C:CC, M221D:CC

CONCEPT

Associations:

- *Pinus virginiana* - (*Pinus rigida*, *Pinus pungens*) / *Schizachyrium scoparium* Forest (CEGL008500, G3G4)
- *Pinus echinata* - *Quercus prinus* / *Rhododendron minus* / *Vaccinium pallidum* Forest (CEGL007496, G2G3)
- *Pinus echinata* - *Quercus stellata* - *Quercus prinus* - *Carya glabra* / (*Danthonia spicata*, *Piptochaetium avenaceum*) Forest (CEGL007500, G3?)
- *Pinus echinata* - *Quercus alba* / *Vaccinium pallidum* / *Hexastylis arifolia* - *Chimaphila maculata* Forest (CEGL008427, G3G4)
- *Pinus echinata* Early-Successional Forest (CEGL006327, GNA)
- *Pinus echinata* - *Quercus prinus* - *Quercus stellata* / *Vaccinium pallidum* / *Pityopsis graminifolia* var. *latifolia* Woodland (CEGL004445, G2?)
- *Pinus strobus* / *Kalmia latifolia* - (*Vaccinium stamineum*, *Gaylussacia ursina*) Forest (CEGL007100, G2G3)
- *Pinus echinata* / *Schizachyrium scoparium* Appalachian Woodland (CEGL003560, G2)
- *Pinus virginiana* - *Pinus (rigida, echinata)* - (*Quercus prinus*) / *Vaccinium pallidum* Forest (CEGL007119, G3)
- *Pinus echinata* - *Quercus stellata* - *Quercus marilandica* / *Vaccinium pallidum* Woodland (CEGL003765, G4?)
- *Pinus echinata* - *Quercus (pinus, falcata)* / *Oxydendrum arboreum* / *Vaccinium pallidum* Forest (CEGL007493, G3G4)
- *Pinus echinata* / *Vaccinium (pallidum, stamineum)* - *Kalmia latifolia* Forest (CEGL007078, G4?)
- *Pinus virginiana* Successional Semi-natural Forest (CEGL002591, GNA)

High-ranked species: *Amorpha schwerinii* (G3G4), *Arabis serotina* (G2), *Botrychium jenmanii* (G3G4), *Canis rufus* (G1Q), *Catocala marmorata* (G3G4), *Cicindela patruela* (G3), *Desmodium ochroleucum* (G1G2), *Gaylussacia brachycera* (G3), *Isotria medeoloides* (G2), *Malaxis bayardii* (G1G2), *Packera millefolia* (G2), *Plethodon hubrichti* (G2), *Puma concolor cougar* (G5THQ), *Taenidia montana* (G3), *Vaccinium hirsutum* (G3), *Virginia valeriana pulchra* (G5T3T4)

Environment: Occurs on ridge tops, upper and mid slopes, in mountain valleys and the lower ranges. Bedrock may be a variety of types, but the system may be limited to acidic substrates. Fire is undoubtedly a very important influence.

Vegetation: Vegetation consists of closed to open forests or woodlands dominated by *Pinus echinata* or *Pinus virginiana*. *Pinus rigida* may sometimes be present. Hardwoods are sometimes abundant, especially dry-site oaks such as *Quercus falcata*, *Quercus prinus*, and *Quercus coccinea*, but also *Carya glabra*, *Acer rubrum*, and others. An extensive hardwood component may partly be the result of fire suppression. The shrub layer may be well-developed, with *Vaccinium pallidum*, *Gaylussacia baccata*, or other acid-tolerant species most characteristic. Herbs are usually sparse but may include *Pityopsis graminifolia* and *Tephrosia virginiana*. Herbs probably were more abundant and shrubs less dense when fires occurred more frequently, and the communities of this system may have been grassy under more natural conditions, with *Schizachyrium scoparium* being a typical component, possibly with *Danthonia* sp.

Dynamics: Little is known about the dynamics of this system. Fire is clearly an important influence, and may be the sole factor determining the occurrence of this system rather than hardwood forests under natural conditions. Fires probably were frequent and of low intensity, or a mix of low and higher intensity. Fire probably is important for determining the balance of the two pine species, the component of hardwoods, and the overall vegetation structure. *Pinus echinata* is fairly resilient to fire once mature, while *Pinus virginiana* individuals are fairly susceptible to fire but well-adapted to establishing in areas opened by intense fire. Southern pine beetles are an important factor in this system, at least under present conditions. Beetle outbreaks can kill all the pines without creating the conditions for the pines to regenerate. Effects of logging and past clearing as well as fire suppression make understanding of this system's natural character and dynamics difficult. An extensive hardwood component may partly be the result of fire suppression. Some pine-dominated areas appear to be successional stands established in former hardwood forests after logging or cultivation, and would not be expected to have the same dynamics or ecosystem characteristics as natural pine forests maintained by fire. In natural pine forests, logging may allow pines to regenerate or may change the composition to weedy hardwoods. It might alter canopy composition as well as structure.

SOURCES

References: Comer et al. 2003, Evans 1991, Eyre 1980, Frost 1998, Harrod and White 1999

Version: 22 Sep 2008

Concept Author: M. Schafale, R. Evans, R. White

Stakeholders: East, Midwest, Southeast

LeadResp: Southeast

G017. Southeastern Great Plains Post Oak - Blackjack Oak Woodland

CES205.682 CROSSTIMBERS OAK FOREST AND WOODLAND

Primary Division: Eastern Great Plains (205)

Land Cover Class: Forest and Woodland

Spatial Scale & Pattern: Matrix

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

National Mapping Codes: EVT 2308; ESLF 4114; ESP 1308

Concept Summary: This system is primarily found within central Texas and Oklahoma, ranging north to southeastern Kansas, and east into eastern Oklahoma. It is distinct from the surrounding prairie by the higher density of tree species. The area consists of irregular plains with primarily sandy to loamy Ustalf soils that range from shallow to moderately deep. Rainfall can be moderate, but somewhat erratic, therefore moisture is often limiting during part of the growing season. Short, stunted *Quercus stellata* and *Quercus marilandica* characterize and dominate this system. Other species, such as *Carya texana*, *Carya cordiformis*, *Quercus prinoides*, *Ulmus crassifolia*, and *Quercus* spp., can also be present within their respective ranges. The understory often contains species typical of the surrounding prairies, in particular *Schizachyrium scoparium*. Shrubs such as *Rhus* spp. may also be present. Drought, grazing, and fire are the primary natural processes that affect this system. Overgrazing and conversion to agriculture, along with fire suppression, have led to the invasion of some areas by problematic brush species such as *Juniperus virginiana* and *Juniperus ashei* and *Prosopis glandulosa* farther south in Texas and Oklahoma. It has also led to decreases in native grass cover allowing for annual grasses and forbs to invade.

Comments: This system currently includes woodlands of the Arbuckle Mountains, as well as a disjunct occurrence in the Wichita Mountains of Oklahoma comprised of the following member: *Quercus fusiformis* - (*Quercus stellata*) / *Schizachyrium scoparium* Granite Woodland (CEGL004937) (B. Hoagland pers. comm. 2005). This vegetation could also be considered an outlier of Edwards Plateau Limestone Savanna and Woodland (CES303.660).

DISTRIBUTION

Range: This system is primarily found within central Texas and Oklahoma, with the northern extent reaching into southeastern Kansas in the Cross Timbers (EPA level III ecoregion 29). It also includes the "Lower Canadian Hills" and "Osage Cuestas" in

eastern Oklahoma and the Edwards Plateau Woodland, Semiarid Edwards Plateau and Broken Red Plains of Texas (37e, 40b, 30a, 30d, 27i of EPA, respectively).

Divisions: 205:C, 303:C

TNC Ecoregions: 28:C, 29:C, 32:C, 33:C

Nations: US

Subnations: AR, KS, MO?, OK, TX

Map Zones: 32:C, 34:P, 35:C, 38:?, 43:C, 44:C

USFS Ecomap Regions: 231G:CC, 251E:CC, 251H:CC, 255A:CC, 255B:C?, 255E:CC, 315C:CC, 315D:CC, 315G:CC, 321B:CC

CONCEPT

Associations:

- *Schizachyrium scoparium* - *Lechea tenuifolia* - *Acalypha radians* Herbaceous Vegetation (CEGL004913, G2G3)
- *Quercus stellata* - *Quercus marilandica* - (*Carya texana*) Forest (CEGL002074, G4)
- *Quercus stellata* - *Quercus marilandica* / *Schizachyrium scoparium* Woodland (CEGL002147, G4)
- *Quercus buckleyi* - *Fraxinus texensis* - *Quercus muehlenbergii* Forest (CEGL004912, G2G3)
- *Quercus stellata* - (*Ulmus crassifolia*) / *Sideroxylon lanuginosum* / *Nassella leucotricha* Paluxy Sands Woodland (CEGL004213, GNR)
- *Schizachyrium scoparium* - *Bouteloua curtipendula* - *Nassella leucotricha* Herbaceous Vegetation (CEGL004070, GNR)
- *Quercus stellata* - *Quercus marilandica* - *Carya texana* - (*Quercus shumardii*, *Quercus velutina*) Forest (CEGL002324, G3G5)
- *Quercus stellata* - *Juniperus virginiana* var. *virginiana* Forest (CEGL004935, GNA)
- *Quercus stellata* - *Ulmus alata* Forest (CEGL004546, GNR)

High-ranked species: *Catocala delilah* (G3G4), *Catocala herodias herodias* (G3T3)

Environment: This system is located on irregular plains comprised of sandy to loamy Ustalf soils. These soils range from shallow to moderately deep. Rainfall can be moderate, but sporadic, leading to periods of limiting moisture. This system also includes smaller patch woodlands dominated by *Quercus stellata* occurring over Mollisols and scattered throughout the limestone uplands of the eastern Edwards Plateau and Lampasas Cutplain of Texas, locally referred to as "Redlands" (B. Carr pers. comm. 2005). The eastern occurrences of this system are associated with sandy members of the Cretaceous Woodbine Formation, while western occurrences occupy soils derived from the sands of the Cretaceous Trinity Group (such as Paluxy, Antler, and Twin Mountain-Travis Peak sands). Further west, in the fringe of the western Crosstimbers, the system occurs on more rugged, rocky and gravelly sites derived from Pennsylvanian formations. The landforms are gently rolling, moderately dissected uplands, and irregular plains becoming more rugged in the western fringe of the distribution of this system. Soils are sands or sandy loams, some with a claypan. Ecological Sites typical of the eastern expressions include Sandy Loam, Tight Sandy Loam, Claypan Prairie, Sandstone Hill, and Sandy. Those more typical of the western expressions include Sandy Loam, Loamy Sand, Tight Sandy Loam, Sandy, and Clay Loam (Elliott 2011).

Vegetation: This system is generally described as a savanna or woodland, distinguished by its dominance by short, stunted *Quercus stellata* and/or *Quercus marilandica*. It occurs in southwest/northeast-trending bands separated by the Grand Prairie. Other species in the canopy may include *Ulmus crassifolia*, *Quercus fusiformis*, *Celtis laevigata*, and *Juniperus virginiana*. The understory may have been historically dominated by *Schizachyrium scoparium*, but current understory composition may be largely determined by land-use history and grazing pressure. *Carya texana*, *Carya cordiformis*, and *Quercus prinoides* are lacking from Texas examples and are mainly present in stands of this system in the northern Crosstimbers of Oklahoma (L. Elliott pers. comm. 2011). In the east, where precipitation is greater, tallgrass species such as *Andropogon gerardii* and *Sorghastrum nutans* may be important components of the understory or occupy prairie patches. In the drier west, shortgrass species such as *Buchloe dactyloides* become more conspicuous. Other graminoid species that may be present include *Schizachyrium scoparium*, *Paspalum setaceum*, *Sporobolus compositus*, *Bouteloua curtipendula*, *Bouteloua hirsuta*, *Bouteloua rigidiseta*, *Bothriochloa laguroides* ssp. *torreyana*, *Nassella leucotricha*, and *Aristida* spp. Non-native species such as *Cynodon dactylon* and *Bothriochloa ischaemum* var. *songarica* frequently dominate the herbaceous layer. With the disruption of a natural fire cycle, branching of overstory species may be continuous to near ground level, reducing light penetration and leading to reduced herbaceous cover. The shrub layer may contain species such as *Smilax bona-nox*, *Rhus glabra*, *Rhus trilobata*, *Crataegus* spp., and *Symphoricarpos orbiculatus*. Sites dominated by *Prosopis glandulosa*, sometimes with *Ziziphus obtusifolia* as a common shrub component, are particularly common to the west. Sites dominated by junipers (including *Juniperus virginiana*, *Juniperus ashei*, and *Juniperus pinchotii*, depending on the site) are also frequently encountered. Prairie openings and inclusions tend to occur on tighter soils. Shrubs such as *Rhus* spp. may also be present. Other species may include *Celtis laevigata*, *Cercis canadensis*, *Cotinus obovatus*, *Fraxinus texensis*, *Gleditsia triacanthos*, *Juniperus ashei*, *Juniperus virginiana* var. *virginiana*, *Quercus fusiformis*, *Quercus buckleyi*, *Quercus velutina*, *Ulmus alata*, and *Ulmus americana* (Elliott 2011).

Dynamics: Drought, grazing, and fire primarily influence this system. Overgrazing and conversion to agriculture have allowed for the invasion of eastern red-cedar (*Juniperus virginiana*), Ashe's juniper (*Juniperus ashei*), and honey mesquite (*Prosopis glandulosa*) in some areas. Decreases in native grass cover associated with overgrazing can also lead to an increase in invasive annual grasses and forbs.

SOURCES

References: Barbour and Billings 1988, Burns and Honkala 1990b, Comer et al. 2003, Elliott 2011, Eyre 1980, Griffith et al. 2004, Hoagland 2000, Hoagland pers. comm., L. Elliott pers. comm., Ricketts et al. 1999

Version: 17 Feb 2011

Concept Author: S. Menard and K. Kindscher

Stakeholders: Midwest, Southeast

LeadResp: Midwest

G159. South-Central Interior Oak Forest & Woodland

CES203.072 CROWLEY'S RIDGE SAND FOREST

Primary Division: Gulf and Atlantic Coastal Plain (203)**Land Cover Class:** Forest and Woodland**Spatial Scale & Pattern:** Large patch**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Upland**Diagnostic Classifiers:** Sand; Unglaciaded**National Mapping Codes:** EVT 2510; ESLF 4332; ESP 1510

Concept Summary: This system of upland shortleaf pine - hardwood forests is confined to Crowley's Ridge on the western side of the Mississippi River. This vegetation is very distinctive from that of the adjacent alluvial plain, and the ridge itself also contrasts sharply with the adjacent alluvial plain. Crowley's Ridge is a remnant loess-capped feature rising from 30 m to over 60 m (100-200 feet) above the alluvial plain surface, to about 150 m (450 feet) above sea level. The base of the northern ridge is comprised of Tertiary substrates overlain by alluvial deposits and capped with generally thin layers of Pleistocene loess. The Pleistocene alluvial deposits are often sandy, and in a very limited area, there are outcrops of sandstone of uncertain origin. Forests on the ridgetops are dominated by *Pinus echinata* with varying amounts of *Quercus alba*, *Quercus rubra*, *Quercus falcata*, *Quercus stellata*, *Carya texana*, and *Quercus velutina*. Loess slopes and ravines are dominated by mesic or dry-mesic hardwood forests such as those of the southern ridge, but are of relatively limited extent.

Comments: This system has been little studied, with the best description in Clark (1974). The presettlement and then-current distribution were mapped, and several sites were sampled. Clark classed the predominant community as Oak-Hickory-Pine, with shortleaf pine dominance ranging from 12-56% and combined white oak and post oak, the most abundant oaks, ranging from 24-60%.

DISTRIBUTION

Range: This system is endemic to Crowley's Ridge in the Mississippi River Alluvial Plain of Arkansas and Missouri (Nelson 2005).**Divisions:** 203:C**TNC Ecoregions:** 42:C**Nations:** US**Subnations:** AR, MO**Map Zones:** 45:C**USFS Ecomap Regions:** 234D:CC

CONCEPT

Associations:

- *Pinus echinata* Crowley's Ridge Forest (CEGL007919, G3G4)
- *Quercus stellata* - *Quercus falcata* / *Ostrya virginiana* Forest (CEGL004064, G1)

Environment: These forests occur on sandy ridges and slopes in a dissected environment. The system is best expressed on northern Crowley's Ridge, but there are limited occurrences on the southern ridge as well, on sandy, exposed sites. They generally lie to the east of hydroxeric Pleistocene terrace flatwoods (now usually converted to cropland) that burned frequently. Those fires would have continued into these dry to dry-mesic forests, thereby increasing the fire frequency.

Vegetation: This system consists of forests that are typically dominated by shortleaf pine with oaks and other hardwoods. Depending upon local soil moisture and other factors, canopy oaks can vary from *Quercus stellata* and *Quercus falcata* on the driest sites to *Quercus alba* and other oaks on more mesic sites. Associated species in the subcanopy and understory vary along this moisture gradient as well (refer to association-level descriptions for more details).

Dynamics: These are fire-adapted forests. There is presumably some natural disturbance from the effects of windstorms and collapse of the fragile loess.

SOURCES

References: Clark 1974, Eyre 1980, NatureServe Ecology - Southeastern U.S. unpubl. data, Nelson 2005, Southeastern Ecology Working Group n.d.

Version: 04 Feb 2009

Concept Author: T. Foti, D. Zollner, M. Pyne

Stakeholders: Midwest, Southeast

LeadResp: Southeast

CES203.531 LOWER MISSISSIPPI RIVER DUNE WOODLAND AND FOREST

Primary Division: Gulf and Atlantic Coastal Plain (203)**Land Cover Class:** Forest and Woodland**Spatial Scale & Pattern:** Large patch**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Forest and Woodland (Treed); Dune (Substrate); Sand Soil Texture

National Mapping Codes: EVT 2381; ESLF 4324; ESP 1381

Concept Summary: This system represents the vegetation of sand dunes and related eolian features of the lower Mississippi River Alluvial Valley in Missouri and Arkansas. These Pleistocene dunes were overlooked or unrecognized until the late 1970s (Saucier 1978). This fact coupled with long periods of weathering and human disturbance, as well as proximity to a terrace mapped as "prairie" in General Land Office records, has led to considerable confusion regarding this type (T. Foti pers. comm.). These dunes are west of Crowley's Ridge and near the Black and White rivers, above the normal flood level of the Mississippi. Examples in Missouri occur amidst a series of low-lying, anastomosing channels that have helped to protect them from extensive alteration more typical in Arkansas where the uplands have been largely cleared. The uppermost portions of the dunes support a xeric community similar to sandhills of the West Gulf Coastal Plain (WGCP), but are outside the natural range of *Quercus incana*, a diagnostic species typical of the WGCP examples. Instead the dunes support very open *Quercus stellata* woodlands with *Schizachyrium scoparium* and abundant lichen cover (presumably *Cladonia* spp.), along with *Opuntia* sp. Less edaphically extreme slopes support more closed-canopied forests in which *Quercus stellata* is still important, along with *Quercus falcata* and possibly other species. In many instances, distinctive wetlands imbedded within this system are also present (Lower Mississippi River Dune Pond (CES203.189)). Called "sand ponds" in Arkansas, these depressions have silty bottoms and perched water tables. The margins of these ponds are rimmed by *Quercus phellos* and have *Quercus lyrata* (Heineke 1987).

Comments: Heineke (1987) states that this large area of eolian sand dunes occurs "mainly in a long band to the west of Crowley's Ridge," and occupies approximately 1000 square kilometers (400 square miles) in discrete fields of up to 78 square kilometers (30 square miles) each. The dunes consist of a layer of sand or sandy loam over an impervious sublayer (Heineke 1987). Depressions in the dune fields (e.g., Lower Mississippi River Dune Pond (CES203.189)) are one of the principal habitats for the rare shrub *Lindera melissifolia*.

DISTRIBUTION

Range: Lower Mississippi River Alluvial Valley in Missouri (Ripley County, Sand Ponds Natural Area) and Arkansas. In Arkansas, examples occur in Clay, Jackson, Lawrence, and Woodruff counties.

Divisions: 202:?, 203:C

TNC Ecoregions: 42:C

Nations: US

Subnations: AR, MO

Map Zones: 45:C

USFS Ecomap Regions: 234D:CC

CONCEPT

Associations:

- *Quercus stellata* - *Quercus marilandica* - *Quercus falcata* / *Schizachyrium scoparium* Sand Woodland (CEGL002417, G2)
- *Schizachyrium scoparium* - *Sorghastrum nutans* - *Aristida lanosa* - *Polypremum procumbens* Herbaceous Vegetation (CEGL002397, G1Q)
- *Quercus stellata* - *Quercus velutina* - *Quercus alba* - (*Quercus falcata*) / *Croton michauxii* Sand Woodland (CEGL002396, G2)

Environment: These dunes are west of Crowley's Ridge and near the Black and White rivers, above the normal flood level of the Mississippi. Examples in Missouri occur amidst a series of low-lying, anastomosing channels that have helped to protect them from extensive alteration more typical in Arkansas where the uplands have been largely cleared. The uppermost portions of the dunes support a xeric community similar to sandhills of the West Gulf Coastal Plain.

Vegetation: The uppermost portions of the dunes support a xeric community of very open *Quercus stellata* woodlands with *Schizachyrium scoparium* and abundant lichen cover (presumably *Cladonia* spp.), along with *Opuntia* sp. Less edaphically extreme slopes support more closed-canopied forests in which *Quercus stellata* is still important, along with *Quercus falcata* and possibly other species.

SOURCES

References: Comer et al. 2003, Eyre 1980, Heineke 1987, Saucier 1978

Version: 26 Jan 2005

Concept Author: T. Foti and R. Evans

Stakeholders: Midwest, Southeast

LeadResp: Southeast

CES202.707 OZARK-OUACHITA DRY OAK WOODLAND

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Forest and Woodland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Ozark/Ouachita

National Mapping Codes: EVT 2364; ESLF 4306; ESP 1364

Concept Summary: This system occurs in the Ozark and Ouachita Highlands and far western portions of the Interior Low Plateau regions along gentle to steep slopes and over bluff escarpments with southerly to westerly aspects. Parent material can range from

calcareous to acidic with very shallow, well- to excessively well-drained soils, sometimes with a fragipan that causes "xero-hydric" moisture conditions. This system was historically woodland in structure, composition, and process but now includes areas of more closed canopy. Oak species such as *Quercus stellata*, *Quercus marilandica*, and *Quercus coccinea* dominate this system with an understory of grassland species such as *Schizachyrium scoparium* and shrub species such as *Vaccinium arboreum*. Drought stress is the major dynamic influencing and maintaining this system. On flatwoods with fragipans, *Quercus stellata* is the major dominant. *Quercus alba*, *Quercus falcata*, and/or *Carya texana* may be present in some stands.

Comments: Dry-mesic to mesic oaks were separated from dry oak per the suggestion of Missouri [see Ozark-Ouachita Dry-Mesic Oak Forest (CES202.708)]. This separation may need to be further reviewed.

DISTRIBUTION

Range: This system occurs in the Western Interior Highlands of the Ozark, Ouachita, and western Interior Low Plateau regions.

Divisions: 202:C

TNC Ecoregions: 38:C, 39:C, 44:C

Nations: US

Subnations: AR, IL, MO, OK

Map Zones: 43:C, 44:C, 49:P

USFS Ecomap Regions: 223A:CC, 231E:CC, 231G:CC, M223A:CC, M231A:CC

CONCEPT

Associations:

- *Quercus alba* - *Quercus stellata* - *Quercus velutina* / *Schizachyrium scoparium* Woodland (CEGL002150, G2G3)
- *Quercus stellata* - *Quercus marilandica* - *Quercus velutina* - *Carya texana* / *Schizachyrium scoparium* Woodland (CEGL002149, G2G3)
- *Quercus marilandica* / *Vaccinium arboreum* / *Danthonia spicata* Scrub Woodland (CEGL002425, G3G4)
- *Quercus velutina* - *Carya (alba, glabra)* / *Vaccinium arboreum* Forest (CEGL004987, G2G3Q)
- *Quercus stellata* - *Quercus marilandica* - *Carya (glabra, texana)* / *Vaccinium arboreum* Forest (CEGL002075, G4)
- *Quercus falcata* - *Quercus alba* - *Quercus stellata* - *Quercus velutina* Forest (CEGL005018, G3G5)
- *Quercus velutina* - *Quercus coccinea* - *Carya texana* Ozark Forest (CEGL002399, GNR)

Environment: This system occurs along gentle to steep slopes and over bluff escarpments with southerly to westerly aspects in the Ozark and Ouachita Highlands and far western portions of the Interior Low Plateau regions. Parent material can range from calcareous to acidic with very shallow, well- to excessively well-drained soils, sometimes with a fragipan that causes "xero-hydric" moisture conditions. Conditions are drier than those of the dry oak woodlands.

Vegetation: Oak species such as *Quercus stellata*, *Quercus marilandica*, and *Quercus coccinea* dominate this system with an understory of grassland species such as *Schizachyrium scoparium* and shrub species such as *Vaccinium arboreum*. Drought stress is the major dynamic influencing and maintaining this system. On flatwoods with fragipans, *Quercus stellata* is the major dominant. *Quercus alba*, *Quercus falcata*, and/or *Carya texana* may be present in some stands. Other species that may be present include *Schizachyrium scoparium*, *Ulmus alata*, and *Vaccinium arboreum*.

SOURCES

References: Comer et al. 2003, Eyre 1980, Nelson 1985

Version: 18 Apr 2012

Concept Author: S. Menard and T. Nigh

Stakeholders: Midwest, Southeast

LeadResp: Midwest

CES202.708 OZARK-OUACHITA DRY-MESIC OAK FOREST

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Forest and Woodland

Spatial Scale & Pattern: Matrix

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Ozark/Ouachita

National Mapping Codes: EVT 2304; ESLF 4110; ESP 1304

Concept Summary: This system is found throughout the Ozark and Ouachita Highlands ranging to the western edge of the Interior Low Plateau. It is the matrix system of this region and occurs on dry-mesic to mesic, gentle to moderately steep slopes. Soils are typically moderately to well-drained and more fertile than those associated with oak woodlands. A closed canopy of oak species (*Quercus rubra* and *Quercus alba*) often associated with hickory species (*Carya* spp.) typifies this system. *Acer saccharum* (or *Acer barbatum* to the south) may occur on more mesic examples of this system. Wind, drought, lightning, and occasional fires can influence this system.

Comments: Dry-mesic to mesic oaks were separated from dry oak (Ozark-Ouachita Dry Oak Woodland (CES202.707)) per the suggestion of Missouri. This separation may need to be further reviewed. Likewise, the distribution of this system versus the one farther north (North-Central Interior Dry-Mesic Oak Forest and Woodland (CES202.046)) needs to be reviewed. Currently the glacial line separates the two systems.

DISTRIBUTION

Range: This system is found throughout the Ozark and Ouachita Highlands, reaching to the western Interior Low Plateau of Illinois.

Divisions: 202:C

TNC Ecoregions: 37:P, 38:C, 39:C, 44:C

Nations: US

Subnations: AR, IL, KS?, MO, OK

Map Zones: 32:P, 43:?, 44:C, 49:C

USFS Ecomap Regions: 223A:CC, 231E:CC, 231G:CC, M223A:CC, M231A:CC

CONCEPT**Associations:**

- *Quercus falcata* - *Carya alba* - *Carya ovata* Forest (CEGL004543, G3Q)
- *Quercus alba* - *Quercus velutina* - *Carya alba* / *Desmodium nudiflorum* Ozark Forest (CEGL004270, G4)
- *Vitis aestivalis* Vine-Shrubland (CEGL003890, G2G3)
- *Quercus alba* - *Quercus rubra* - *Quercus muehlenbergii* / *Cercis canadensis* Forest (CEGL002070, G4G5)
- *Quercus alba* - *Carya alba* / *Ostrya virginiana* / *Carex pensylvanica* - *Schizachyrium scoparium* Forest (CEGL007818, G3Q)
- *Liquidambar styraciflua* - *Quercus* (*alba*, *falcata*) Semi-natural Forest (CEGL007217, GNA)
- *Quercus alba* - *Quercus rubra* - *Carya* (*alba*, *ovata*) / *Cornus florida* Acidic Forest (CEGL002067, G3)
- *Quercus rubra* - *Quercus shumardii* Forest (CEGL004796, G3?)
- *Quercus velutina* - *Quercus alba* - *Carya* (*glabra*, *ovata*) Forest (CEGL002076, G4?)
- *Quercus prinus* / *Smilax* spp. Forest (CEGL005022, G4)
- *Quercus alba* / *Cornus florida* Unglaciated Forest (CEGL002066, G4?)
- *Juniperus virginiana* - *Quercus* (*alba*, *stellata*) - *Carya texana* Forest (CEGL004803, GNR)
- *Acer saccharum* - *Quercus muehlenbergii* / *Cotinus obovatus* Forest (CEGL004795, G2G3Q)
- *Quercus muehlenbergii* - *Quercus shumardii* Forest (CEGL004602, G2G4)

High-ranked species: *Cardamine angustata* var. *ouachitana* (G5T3Q), *Delphinium newtonianum* (G3), *Tradescantia ozarkana* (G3)

Environment: This is the matrix system of this region and occurs on dry-mesic to mesic, gentle to moderately steep slopes. Soils are typically moderately to well-drained and more fertile than those associated with oak woodlands.

Vegetation: A closed canopy of oak species (*Quercus rubra*, *Quercus muehlenbergii*, and *Quercus alba*) often associated with hickory species (*Carya* spp.) typifies this system. *Acer saccharum* (or *Acer barbatum* to the south) may occur in more mesic examples. Some stands in the western edge of the Interior Low Plateau (eastern range limit of the system) may contain *Quercus prinus*. Some other species which may be present include *Carex pensylvanica*, *Carya alba*, *Carya cordiformis*, *Carya glabra*, *Carya ovata*, *Cercis canadensis*, *Cornus florida*, *Fagus grandifolia*, *Fraxinus americana*, *Gleditsia triacanthos*, *Gymnocladus dioica*, *Hybanthus concolor*, *Juglans nigra*, *Juniperus virginiana*, *Lindera benzoin*, *Liquidambar styraciflua*, *Maclura pomifera*, *Ostrya virginiana*, *Quercus alba*, *Quercus falcata*, *Quercus marilandica*, *Quercus shumardii*, *Quercus velutina*, *Schizachyrium scoparium*, *Smilax* spp., *Ulmus americana*, *Ulmus serotina*, and *Vitis aestivalis*.

Dynamics: Wind, drought, lightning, and occasional fires can influence this system.

SOURCES

References: Comer et al. 2003, Eyre 1980, Nelson 1985

Version: 18 Apr 2012

Concept Author: S. Menard

Stakeholders: Midwest, Southeast

LeadResp: Midwest

CES202.898 SOUTHERN INTERIOR LOW PLATEAU DRY-MESIC OAK FOREST

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Forest and Woodland

Spatial Scale & Pattern: Matrix

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

National Mapping Codes: EVT 2305; ESLF 4111; ESP 1305

Concept Summary: This system of upland hardwood-dominated forests occurs in the Interior Low Plateau region of the southeastern United States along ridgetops and slopes of various aspects. The system includes essentially all upland hardwood stands of the region except for mesic hardwood forests (which are accommodated by South-Central Interior Mesophytic Forest (CES202.887)). The floristic expression of different stands included in this system varies considerably with aspect and soil type. Included here are a variety of associations ranging along a moisture gradient from submesic to drier ones. The submesic to dry-mesic expressions tend to be found on midslopes with northerly to easterly aspects, and the drier ones on southerly to westerly aspects and on broad ridges. Parent material can range from calcareous to acidic with very shallow, well- to excessively well-drained soils in the drier expressions and moderately well-drained soils in the submesic to dry-mesic ones. The canopy closure of this system ranges from closed to somewhat open in the drier examples. Historically, these examples may have been more open under conditions of more frequent fire.

A number of different *Quercus* species may dominate stands of this system, with *Carya* species also prominent. In some drier examples on more acidic substrates, *Quercus prinus* is typical over most of the range, reflecting relations with other Appalachian systems to the east. In addition, *Quercus stellata*, *Quercus marilandica*, and *Quercus coccinea* will also share dominance or be prominent in many of the drier examples. *Quercus muehlenbergii* and/or *Quercus shumardii* may appear in drier examples with high base status. *Quercus alba* may also be present but not typically dominant. In the submesic to dry-mesic examples, *Quercus alba* will typically exhibit dominance, possibly with *Quercus velutina* or *Quercus falcata*. The understories are typically shrub- and small tree-dominated, with the typical species varying with aspect, soil, and moisture relations.

Comments: The range of this system is consistent with the non-coastal plain portion of the "Western Mesophytic" Forest region of Braun (1950), Keever (1971), and Greller (1988). To the glaciated north, it is replaced by North-Central Interior Dry-Mesic Oak Forest and Woodland (CES202.046) or North-Central Interior Dry Oak Forest and Woodland (CES202.047).

DISTRIBUTION

Range: This system occurs in the southeastern Interior Highlands of the Interior Low Plateau region, including southern Indiana and a small part of southeastern Ohio.

Divisions: 202:C

TNC Ecoregions: 44:C

Nations: US

Subnations: AL, IL, IN, KY, OH, TN

Map Zones: 47:C, 48:C, 49:C, 53:C

USFS Ecomap Regions: 223B:CC, 223D:CC, 223E:CC, 223F:CC, 231C:CC

CONCEPT

Associations:

- *Quercus muehlenbergii* - *Quercus (falcata, shumardii, stellata)* / *Cercis canadensis* / *Viburnum rufidulum* Forest (CEGL007699, G3)
- *Quercus alba* - *Carya alba* - (*Quercus velutina*) / *Desmodium nudiflorum* - (*Carex picta*) Forest (CEGL007795, G4)
- *Quercus muehlenbergii* - *Quercus shumardii* - *Carya (carolinae-septentrionalis, ovata)* Forest (CEGL007808, G3)
- *Quercus falcata* - *Quercus alba* - *Carya alba* / *Oxydendrum arboreum* / *Vaccinium stamineum* Forest (CEGL007244, G4G5)
- *Quercus falcata* - *Quercus (coccinea, stellata)* / *Vaccinium (pallidum, stamineum)* Forest (CEGL007247, G4)
- *Quercus alba* - *Quercus rubra* - *Quercus muehlenbergii* / *Cercis canadensis* Forest (CEGL002070, G4G5)
- *Juniperus virginiana* var. *virginiana* - (*Quercus* spp.) Forest (CEGL007124, GNA)
- *Liriodendron tulipifera* - *Quercus* spp. Semi-natural Forest (CEGL007221, GNA)
- *Quercus prinus* - *Quercus* spp. / *Vaccinium arboreum* - (*Kalmia latifolia*, *Styrax grandifolius*) Forest (CEGL007700, G4)
- *Liquidambar styraciflua* - *Quercus (alba, falcata)* Semi-natural Forest (CEGL007217, GNA)
- *Robinia pseudoacacia* Semi-natural Forest (CEGL007279, GNA)
- *Prunus serotina* - *Sassafras albidum* - (*Fraxinus americana*) / *Juniperus virginiana* Semi-natural Forest (CEGL004133, GNA)
- *Quercus pagoda* - (*Quercus falcata*) / *Ostrya virginiana* Forest (CEGL003871, G3?)
- *Quercus alba* - *Quercus (falcata, stellata)* / *Chasmanthium laxum* Forest (CEGL007746, G3G4Q)
- *Quercus alba* - *Quercus rubra* - *Carya (alba, ovata)* / *Cornus florida* Acidic Forest (CEGL002067, G3)
- *Quercus velutina* - *Carya (alba, glabra)* / *Vaccinium arboreum* Forest (CEGL004987, G2G3Q)
- *Quercus falcata* - *Quercus (coccinea, stellata)* / *Schizachyrium scoparium* Woodland (CEGL004214, GNA)
- *Quercus velutina* - *Quercus alba* - *Carya (glabra, ovata)* Forest (CEGL002076, G4?)
- *Quercus rubra* - (*Acer saccharum*, *Quercus alba*) Forest (CEGL005017, G4?)
- *Quercus prinus* - *Carya ovata* - *Quercus rubra* / *Acer saccharum* Forest (CEGL007268, G4?)
- *Quercus prinus* / *Smilax* spp. Forest (CEGL005022, G4)
- *Quercus stellata* - *Quercus marilandica* - *Carya (glabra, texana)* / *Vaccinium arboreum* Forest (CEGL002075, G4)
- *Quercus stellata* / *Viburnum rufidulum* / *Schizachyrium scoparium* - (*Sorghastrum nutans*, *Helianthus eggertii*) Woodland (CEGL004686, G2G3)
- *Quercus falcata* - *Quercus alba* - *Quercus stellata* - *Quercus velutina* Forest (CEGL005018, G3G5)
- *Quercus shumardii* - *Quercus muehlenbergii* - *Acer (barbatum, leucoderme, saccharum)* / *Ostrya virginiana* Forest (CEGL008442, G2G3)
- *Quercus imbricaria* - *Quercus shumardii* - *Quercus muehlenbergii* / *Celtis occidentalis* / *Urtica chamaedryoides* Forest (CEGL003876, G2G3)
- *Liriodendron tulipifera* / (*Cercis canadensis*) / (*Lindera benzoin*) Semi-natural Forest (CEGL007220, GNA)
- *Quercus alba* / *Cornus florida* Unglaciated Forest (CEGL002066, G4?)
- *Pinus echinata* - *Quercus prinus* Interior Low Plateau Forest (CEGL004054, G2G3)

Environment: This system encompasses a variety of associations ranging along a moisture gradient from submesic to drier ones. The submesic to dry-mesic expressions tend to be found on midslopes with northerly to easterly aspects, the drier ones on southerly to westerly aspects and on broad ridges. Parent material can range from calcareous to acidic with very shallow, well- to excessively well-drained soils in the drier expressions and moderately well-drained soils in the submesic to dry-mesic ones.

Vegetation: A number of different *Quercus* species may dominate stands of this system, with *Carya* species also prominent. In the drier examples, *Quercus prinus* is typical over most of the range, reflecting relations with other Appalachian systems to the east. In addition, *Quercus stellata*, *Quercus marilandica*, and *Quercus coccinea* will also share dominance or be prominent in many of the drier examples. *Quercus muehlenbergii* and/or *Quercus shumardii* may appear in drier examples with high base status. *Quercus alba* may also be present but not typically dominant. In the submesic to dry-mesic examples, *Quercus alba* will typically exhibit dominance, possibly with *Quercus velutina* or *Quercus falcata*. The understories are typically shrub- and small tree-dominated, with the typical species varying with aspect, soil, and moisture relations. Some typical species include *Cornus florida*, *Cercis canadensis*, *Oxydendrum arboreum*, *Vaccinium pallidum*, *Vaccinium stamineum*, *Vaccinium arboreum*, other highbush *Vaccinium* species, *Kalmia latifolia*, *Viburnum acerifolium*, *Styrax americanus*, and others. Some more open and drier stands may exhibit an understory of grassland species such as *Schizachyrium scoparium*, *Danthonia spicata*, and others. Forbs of the Fabaceae (e.g., *Desmodium*) and Asteraceae (e.g., *Helianthus*) will be prominent in many examples.

SOURCES

References: Braun 1950, Comer et al. 2003, Evans 1991, Eyre 1980, Greller 1988, Keever 1971

Version: 22 Jan 2008

Concept Author: M. Pyne

Stakeholders: Midwest, Southeast

LeadResp: Southeast

M151. NORTHERN GREAT PLAINS WOODLAND

G145. Great Plains Wooded Draw & Ravine

CES303.680 GREAT PLAINS WOODED DRAW AND RAVINE

Primary Division: Western Great Plains (303)

Land Cover Class: Mixed Upland and Wetland

Spatial Scale & Pattern: Linear

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland

National Mapping Codes: EVT 2385; ESLF 4328; ESP 1385

Concept Summary: This ecological system is typically found associated with permanent or ephemeral streams though it may occur on steep northern slopes or within canyon bottoms that do not experience periodic flooding. Soil moisture and topography allow greater moisture conditions compared to the surrounding areas. Occurrences can be either tree-dominated or predominantly shrubland. *Fraxinus pennsylvanica* with *Ulmus rubra* or *Ulmus americana* typically dominate this system, although *Juniperus scopulorum* can dominate the canopy in the western Great Plains and *Juniperus virginiana* in the east. *Populus tremuloides*, *Betula papyrifera*, or *Acer negundo* are commonly present in portions of the northwestern Great Plains, for example in areas of central and eastern Montana. In south-central and east-central portions of the Great Plains, *Quercus macrocarpa* can also be present. Wetter areas within this system can have significant amounts of *Populus deltoides*. Component shrubs can include *Cornus sericea*, *Crataegus douglasii*, *Crataegus chrysocarpa*, *Crataegus succulenta*, *Elaeagnus commutata*, *Prunus virginiana*, *Rhus* spp., *Rosa woodsii*, *Shepherdia argentea*, *Symphoricarpos occidentalis*, or *Viburnum lentago*. Common grasses can include *Calamagrostis stricta*, *Carex* spp., *Pascopyrum smithii*, *Piptatherum micranthum*, *Pseudoroegneria spicata*, or *Schizachyrium scoparium*. This system was often subjected to heavy grazing and trampling by both domestic animals and wildlife and can be heavily degraded in some areas. In addition, exotic species such as *Ulmus pumila* and *Elaeagnus angustifolia* can invade these systems.

Comments: More information from the broader division and from the Rocky Mountain division will be needed to determine if those areas dominated by ash and elm should be separated from areas dominated by *Juniperus scopulorum*. Those areas dominated by *Juniperus* are typically found in the Badlands and the western portions of North Dakota and Nebraska, and should probably be described based on data from the Great Plains Steppe or Rocky Mountain division. However, *Juniperus* can occur in stands with elm and ash in Nebraska and North Dakota. Expanded range into the central Great Plains (parts of Provinces 332 and 251). Possibly consider splitting the western Great Plains stands from the central Great Plains stands but there are currently not enough floristic and environmental differences known between stands in the two areas to justify that.

DISTRIBUTION

Range: This system is found throughout the Western Great Plains Division and east into the western tallgrass prairie zone of the central United States. In Wyoming, it occurs in the northeastern foothills of the Bighorns and across far-northeastern Wyoming into the northern fringes of the Black Hills.

Divisions: 205:P, 303:C

TNC Ecoregions: 26:C, 27:C, 33:C, 34:C, 36:C, 37:C

Nations: US

Subnations: CO, IA, KS, MO, MT, ND, NE, OK, SD, WY

Map Zones: 20:C, 27:P, 28:P, 29:C, 30:C, 31:C, 33:C, 34:C, 35:?, 38:C, 39:C, 40:C, 43:C

USFS Ecomap Regions: 251C:CC, 251F:CC, 251H:CC, 331D:CP, 331E:CP, 331F:CC, 331G:CP, 331H:C?, 331K:CC, 331L:CC, 331M:CP, 331N:C?, 332C:CC, 332E:CC, M331B:??, M331I:??, M334A:PP

CONCEPT

Associations:

- *Juniperus scopulorum* / *Schizachyrium scoparium* Woodland (CEGL000750, G2)
- *Juniperus scopulorum* Woodland (CEGL003550, GNR)
- *Populus deltoides* - *Fraxinus pennsylvanica* Forest (CEGL000658, G2G3)
- *Juniperus scopulorum* / *Cornus sericea* Woodland (CEGL000746, G4)
- *Fraxinus pennsylvanica* - *Ulmus* spp. - *Celtis occidentalis* Forest (CEGL002014, G3G5)
- *Cornus sericea* Rocky Mountain Shrubland (CEGL001165, G4Q)
- *Cornus drummondii* - (*Rhus glabra*, *Prunus* spp.) Shrubland (CEGL005219, GNA)
- *Cornus drummondii* - *Amorpha fruticosa* - *Cornus sericea* Shrubland (CEGL005220, G4?)
- *Fraxinus pennsylvanica* - (*Ulmus americana*) / *Symphoricarpos occidentalis* Forest (CEGL002088, G4?)
- *Symphoricarpos occidentalis* Shrubland (CEGL001131, G4G5)
- *Shepherdia argentea* Shrubland (CEGL001128, G3G4)
- *Elaeagnus commutata* / *Pascopyrum smithii* Shrubland (CEGL001099, G3?)
- *Crataegus douglasii* - (*Crataegus chrysocarpa*) Shrubland (CEGL001093, G2Q)
- *Populus deltoides* (ssp. *wislizeni*, ssp. *monilifera*) / *Pascopyrum smithii* Woodland (CEGL002680, G3)
- *Crataegus succulenta* Shrubland (CEGL001097, G3G4Q)
- *Fraxinus pennsylvanica* - *Ulmus americana* / *Symphoricarpos occidentalis* Forest (CEGL002082, G3G5)
- *Juniperus scopulorum* / *Piptatherum micranthum* Woodland (CEGL000747, G3G4)
- *Populus deltoides* / *Carex pellita* Woodland (CEGL002649, G2)
- *Quercus macrocarpa* / *Prunus virginiana* - *Symphoricarpos occidentalis* Woodland (CEGL002138, G3G4)
- *Populus deltoides* / *Symphoricarpos occidentalis* Woodland (CEGL000660, G2G3)
- *Elaeagnus commutata* Shrubland (CEGL001098, G2Q)
- *Prunus virginiana* - (*Prunus americana*) Shrubland (CEGL001108, G4Q)
- *Rosa woodsii* Shrubland (CEGL001126, G5)
- *Juniperus scopulorum* / *Pseudoroegneria spicata* Woodland (CEGL000748, G4)
- *Carex nebrascensis* Herbaceous Vegetation (CEGL001813, G4)
- *Cornus sericea* - *Salix* (*bebbiana*, *discolor*, *petiolaris*) / *Calamagrostis stricta* Shrubland (CEGL002187, G3G4)
- *Betula papyrifera* / *Corylus cornuta* Forest (CEGL002079, G2G3)
- *Fraxinus pennsylvanica* - *Ulmus americana* / *Prunus virginiana* Woodland (CEGL000643, G2G3)

Environment: This system is associated with permanent or ephemeral streams. It also can occur on steep northern slopes or within canyon bottoms that do not experience periodic flooding. Soils are primarily wet to mesic, and the more sheltered and lower landscape position allows for greater moisture conditions compared to the surrounding areas.

Vegetation: Species composition can vary across the range of this system. *Fraxinus pennsylvanica* and *Ulmus* spp. typically dominate this system. In some western areas of the Great Plains Division, *Juniperus* spp. can dominate, and in the south-central and east-central portions of the Great Plains, *Quercus macrocarpa* can also be important. *Tilia americana* and *Ostrya virginiana* are also common associates in the eastern portion of this system's range. Exotic species, such as *Ulmus pumila* and *Elaeagnus angustifolia*, can be present in degraded examples. Wetter areas within this system can have significant amounts of *Populus deltoides*.

Dynamics: Fire can influence this system; however, grazing is the most prevalent dynamic process influencing this system. Overgrazing can heavily degrade this system, particularly the understory, and allow for the invasion of exotic species.

SOURCES

References: Comer et al. 2003, Eyre 1980, Rolfsmeier and Steinauer 2010

Version: 06 Dec 2012

Stakeholders: Midwest, Southeast, West

Concept Author: S. Menard and K. Kindscher

LeadResp: Midwest

G146. Eastern Great Plains Tallgrass Aspen Parkland

CES205.688 EASTERN GREAT PLAINS TALLGRASS ASPEN PARKLAND

Primary Division: Eastern Great Plains (205)

Land Cover Class: Forest and Woodland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

National Mapping Codes: EVT 2331; ESLF 4137; ESP 1331

Concept Summary: This system is found primarily on part of the Glacial Lake Agassiz plain in northwestern Minnesota, ranging into southern Canada. Calcareous glacial drift overlain with lacustrine soils ranging from loamy to gravelly is characteristic of the lakeplain within the range of this system. Historically this system included a mosaic of tallgrass prairie, wet prairie, brush prairie and aspen-oak woodlands. It is dominated by *Populus tremuloides* with scattered *Quercus macrocarpa* and *Betula papyrifera*. Shrubs such as willow (*Salix* spp.) and hazel (*Corylus* spp.) are also common. The dominant tallgrass species is *Andropogon gerardii* often associated with *Sorghastrum nutans*, *Calamagrostis* spp., and *Sporobolus heterolepis*. Fire is the most important natural dynamic in

this system and helps maintain the open parkland or brush nature of this system. Wind and grazing are also important dynamics. Conversion to agriculture and fire suppression have decreased the range of this system and allowed more shrubs and trees to establish.

DISTRIBUTION

Range: This system is found primarily on part of the Glacial Lake Agassiz plain in northwestern Minnesota, ranging into southern Canada.

Divisions: 201:P, 205:C

TNC Ecoregions: 35:C, 46:?, 47:P, 66:P

Nations: CA, US

Subnations: MB, MN, ND

Map Zones: 39:P, 40:C, 41:P

USFS Ecomap Regions: 222N:CC, 251A:PP

CONCEPT

Associations:

- *Populus tremuloides* / *Corylus americana* Forest (CEGL002063, G5)
 - *Populus tremuloides* - *Quercus macrocarpa* - *Salix* spp. / *Andropogon gerardii* Shrubland (CEGL002182, G2G3)
 - *Quercus macrocarpa* - *Populus tremuloides* / *Corylus* spp. Woodland (CEGL002139, G4?)
 - *Populus tremuloides* / *Corylus* spp. / *Andropogon gerardii* Woodland (CEGL005205, G4G5)
 - *Betula papyrifera* / *Corylus cornuta* Forest (CEGL002079, G2G3)
 - *Salix petiolaris* - (*Betula pumila*) / *Spartina pectinata* - *Carex pellita* Shrubland (CEGL002434, G3)
- High-ranked species:** *Anisota manitobensis* (G1G2Q), *Grus americana* (G1), *Oarisma poweshiek* (G1), *Papaipema beeriana* (G2G3)

SOURCES

References: Comer et al. 2003, Eyre 1980, MNNHP 1993

Version: 11 Apr 2007

Concept Author: S. Menard

Stakeholders: Canada, Midwest

LeadResp: Midwest

M153. CENTRAL MESOPHYTIC HARDWOOD FOREST

G020. Appalachian & Interior Mesic Forest

CES202.043 OZARK-OUACHITA MESIC HARDWOOD FOREST

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Forest and Woodland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Forest and Woodland (Treed); Ozark/Ouachita

National Mapping Codes: EVT 2334; ESLF 4140; ESP 1334

Concept Summary: This system is found on lower slopes, toeslopes and valley bottoms within the Ozark and Ouachita regions, as well as on north slopes. In the Ozarks, *Quercus rubra* increases in abundance compared to dry-mesic habitats, and *Acer saccharum* is sometimes a leading dominant. On more alkaline moist soils, *Quercus muehlenbergii*, *Tilia americana*, and *Cercis canadensis* may be common. In the Boston Mountains, mesic forests may also be common on protected slopes and terraces next to streams. Here, *Fagus grandifolia* may be the leading dominant, with codominants of *Acer saccharum*, *Liquidambar styraciflua*, *Tilia americana*, *Magnolia acuminata*, *Magnolia tripetala*, and others. Similar habitats occur in the western Ouachita Mountains.

DISTRIBUTION

Range: This system is found within the Ozarks and Ouachita Mountains of Missouri, Arkansas, and Oklahoma.

Divisions: 202:C

TNC Ecoregions: 38:C, 39:C

Nations: US

Subnations: AR, MO, OK

Map Zones: 44:C, 49:P

USFS Ecomap Regions: 223A:CC, 231E:CC, 231G:CC, M223A:CC, M231A:CC

CONCEPT

Associations:

- *Fagus grandifolia* - *Acer saccharum* - *Liriodendron tulipifera* Unglaciaded Forest (CEGL002411, G4?)
- *Acer (saccharum, barbatum)* - *Quercus rubra* - *Carya cordiformis* / *Asimina triloba* Forest (CEGL002060, G3)
- *Quercus muehlenbergii* - *Acer saccharum* Southeastern Oklahoma Forest (CEGL004662, G2G4)

- *Fagus grandifolia* - *Quercus rubra* - *Tilia americana* var. *caroliniana* / *Magnolia tripetala* / *Podophyllum peltatum* Forest (CEGL007823, G3G4)
- *Acer (barbatum, saccharum)* - *Juglans nigra* - *Fraxinus americana* / *Hybanthus concolor* Forest (CEGL007811, G2)
- *Quercus alba* - *Quercus rubra* - *Acer saccharum* - *Carya cordiformis* / *Lindera benzoin* Forest (CEGL002058, G3?)

High-ranked species: *Cardamine angustata* var. *ouachitana* (G5T3Q), *Carex latebracteata* (G3), *Delphinium newtonianum* (G3), *Tradescantia ozarkana* (G3)

Environment: This system is typically found in protected environments such as lower slopes, toeslopes, north-facing slopes, and valley bottoms and terraces next to streams within the Ozark and Ouachita regions.

Vegetation: Dominant or characteristic trees in examples of this system may include *Quercus alba*, *Quercus rubra*, *Acer barbatum*, *Acer saccharum*, *Fagus grandifolia*, *Liquidambar styraciflua*, *Quercus muehlenbergii*, and *Tilia americana*. The understory may contain *Cercis canadensis*, *Magnolia tripetala*, and/or *Magnolia acuminata*. Some common shrubs include *Asimina triloba* and *Lindera benzoin*. Stands will typically have diverse ground layers. Some typical herbs include *Podophyllum peltatum* and *Hybanthus concolor*.

SOURCES

References: Barnes 1991, Comer et al. 2003, Eyre 1980, Nelson 1985

Version: 23 Feb 2010

Concept Author: R. Evans, D. Faber-Langendoen

Stakeholders: Midwest, Southeast

LeadResp: Southeast

CES202.887 SOUTH-CENTRAL INTERIOR MESOPHYTIC FOREST

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Forest and Woodland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Forest and Woodland (Treed); Sideslope; Unglaciaded; Eutrophic Soil; Broad-Leaved Deciduous Tree

National Mapping Codes: EVT 2321; ESLF 4127; ESP 1321

Concept Summary: These high-diversity, predominately deciduous forests occur on deep and enriched soils (in some cases due to, or enhanced by, the presence of limestone or related base-rich geology), in non-montane settings and usually in somewhat protected landscape positions such as coves or lower slopes. The core distribution of this system lies in the Cumberland and Allegheny plateaus, extending into the adjacent southern Ridge and Valley and portions of the Interior Low Plateau where it is located entirely south of the glacial boundary. Dominant species include *Acer saccharum*, *Fagus grandifolia*, *Liriodendron tulipifera*, *Tilia americana*, *Quercus rubra*, *Magnolia acuminata*, and *Juglans nigra*. *Tsuga canadensis* may be a component of some stands. Trees may grow very large in undisturbed areas. The herb layer is very rich, often with abundant spring ephemerals. Many examples may be bisected by small streams.

Comments: Southern and Central Appalachian Cove Forest (CES202.373) (Ecoregions 51 and 59) is being treated as a separate system. The concept of this type (CES202.887) is more-or-less consistent with the "Mixed Mesophytic Communities" of both the Mixed Mesophytic Forest Region and the non-coastal plain portion of the Western Mesophytic Forest Region, extending north into unglaciaded portions of the Beech-Maple Forest Region, of Braun (1950) and Greller (1988). There is much variability in different examples of this system across its range, with the composition of some occurrences in the escarpment of the Cumberland Plateau approaching that of examples of Southern and Central Appalachian Cove Forest (CES202.373). The Allegheny Front is adopted as the divide between these two similar systems: material to the west goes to this system, and material to the east goes to Southern and Central Appalachian Cove Forest (CES202.373). In limited areas of the region, some stands may contain hemlock (*Tsuga canadensis*). These are noteworthy on a local basis, as the tree is less well distributed in the range of this system than it is in corresponding environments at higher elevation in the Appalachians or to the north.

DISTRIBUTION

Range: This system occurs in southeastern Ohio east to Virginia, West Virginia, Kentucky, Tennessee, Georgia, and Alabama, with disjunct occurrences in unglaciaded southwestern Pennsylvania and southwestern New York. This range is more-or-less consistent with the "Mixed Mesophytic" and "Western Mesophytic" (non-coastal plain portion only) forest regions of Braun (1950) and Greller (1988), although it does extend into unglaciaded portions of the "Beech-Maple" region to the north. Thus, this system is most extensive in the Cumberland and Allegheny plateaus, as well as the unglaciaded Interior Low Plateau, and becomes relatively limited in extent towards its western limit in the Ozark Hills of Illinois, and towards its northern limit in southwestern New York.. It is replaced in the Upper East Gulf Coastal Plain by other systems. Its range also includes the southern Ridge and Valley from Tennessee (and adjacent southwestern Virginia) to Alabama. Parts of the Cumberland Mountains (EPA 69 in Kentucky and Tennessee) are instead occupied by Southern and Central Appalachian Cove Forest (CES202.373). North-Central Interior Beech-Maple Forest (CES202.693) replaces this one in EPA 72b of Indiana.

Divisions: 202:C

TNC Ecoregions: 44:C, 49:C, 50:C, 60:C

Nations: US

Subnations: AL, GA, IL, IN, KY, NY, OH, PA, TN, VA, WV

Map Zones: 47:C, 48:C, 49:C, 53:C, 57:C, 61:C, 62:C, 63:C**USFS Ecomap Regions:** 211G:CC, 221E:CC, 221F:C?, 221H:CC, 223D:CC, 223E:CC, 223F:CC, 231C:CC, 231D:CC, M221C:CC

CONCEPT

Associations:

- *Acer saccharum* - *Liriodendron tulipifera* - *Fraxinus americana* / *Staphylea trifolia* Forest (CEGL006201, G4?)
- *Quercus alba* - *Fagus grandifolia* Western Allegheny Plateau Forest (CEGL006144, GNR)
- *Fagus grandifolia* - *Quercus alba* / *Cornus florida* Forest (CEGL007881, G4)
- *Quercus alba* - (*Liriodendron tulipifera*, *Liquidambar styraciflua*) / *Calycanthus floridus* / *Athyrium filix-femina* Forest (CEGL008428, G3G4)
- *Tsuga canadensis* - (*Liriodendron tulipifera*, *Fagus grandifolia*) / (*Magnolia macrophylla*, *Ilex opaca*) / *Polystichum acrostichoides* Forest (CEGL004767, G1G2)
- *Acer saccharum* - *Carya ovata* - *Juglans nigra* / *Symphoricarpos orbiculatus* / *Galium circaezans* Forest (CEGL004741, G3G4)
- *Fagus grandifolia* - *Acer saccharum* - *Liriodendron tulipifera* Unglaciated Forest (CEGL002411, G4?)
- *Juglans nigra* / *Verbesina alternifolia* Semi-natural Forest (CEGL007879, GNA)
- *Acer saccharum* - *Fraxinus americana* - *Tilia americana* - *Liriodendron tulipifera* / *Actaea racemosa* Forest (CEGL006237, G4?)
- *Tsuga canadensis* - *Fagus grandifolia* - *Acer saccharum* / (*Hamamelis virginiana*, *Kalmia latifolia*) Forest (CEGL005043, G3?)
- *Quercus alba* - *Quercus rubra* - *Carya ovalis* / *Acer saccharum* / *Polystichum acrostichoides* Forest (CEGL007233, G4)
- *Quercus rubra* - *Tilia americana* var. *heterophylla* - *Carya carolinae-septentrionalis* / *Acer (barbatum, leucoderme)* / *Hydrangea quercifolia* Forest (CEGL008488, G2G3)
- *Quercus rubra* - *Acer saccharum* - *Tilia americana* var. *heterophylla* - *Aesculus flava* - (*Cladrastis kentukea*) Forest (CEGL007698, G3)
- *Fagus grandifolia* Ridge and Valley Forest (CEGL007200, G3G4Q)
- *Fagus grandifolia* - *Liriodendron tulipifera* / *Euonymus americanus* / *Athyrium filix-femina* ssp. *asplenioides* Forest (CEGL007201, G4)
- *Liriodendron tulipifera* / (*Cercis canadensis*) / (*Lindera benzoin*) Semi-natural Forest (CEGL007220, GNA)
- *Liriodendron tulipifera* - *Tilia americana* var. *heterophylla* - *Aesculus flava* - *Acer saccharum* / (*Magnolia tripetala*) Forest (CEGL005222, G4?)
- *Quercus alba* - *Fagus grandifolia* / *Hydrangea quercifolia* - *Viburnum acerifolium* / *Carex picta* - *Polystichum acrostichoides* Forest (CEGL007213, G3G4)

High-ranked species: *Aconitum reclinatum* (G3), *Actaea rubifolia* (G3), *Aesculus parviflora* (G3), *Aneides aeneus* (G3G4), *Arabis patens* (G3), *Brachythecium rotaeanum* (G3G4), *Bryoerythrophyllum ferruginascens* (G3G4), *Calystegia catesbeiana* ssp. *sericata* (G3T3Q), *Canis rufus* (G1Q), *Cardamine clematidis* (G3), *Cardamine flagellifera* (G3), *Carex manhartii* (G3G4), *Carex radfordii* (G2), *Carex roanensis* (G2G3), *Catocala marmorata* (G3G4), *Clematis addisonii* (G1?), *Collinsonia verticillata* (G3G4), *Delphinium alabamicum* (G2), *Desmognathus aeneus* (G3G4), *Desmognathus imitator* (G3G4), *Desmognathus santeetlah* (G3G4Q), *Desmognathus wrightii* (G3), *Diervilla rivularis* (G3), *Drepanolejeunea appalachiana* (G2?), *Entodon sullivantii* (G3G4), *Euphorbia purpurea* (G3), *Hydrastis canadensis* (G3G4), *Hygrohypnum closteri* (G3), *Lejeunea blomquistii* (G1G2), *Lophocolea appalachiana* (G1G2Q), *Marsupella emarginata* var. *latiloba* (G5T1T2), *Megaceros aenigmaticus* (G3), *Melanoplus acrophilus acrophilus* (G2G3T2T3), *Melanoplus cherokee* (G1G3), *Melanoplus divergens* (G2G3), *Melanoplus serrulatus* (G1G3), *Metzgeria fruticulosa* (G2Q), *Metzgeria uncigera* (G3), *Microtus chrotorrhinus carolinensis* (G4T3), *Nesticus sheari* (G2?), *Nevisia alabamensis* (G2), *Panax quinquefolius* (G3G4), *Pieris virginensis* (G3?), *Plagiochila austinii* (G3), *Plagiochila caduciloba* (G2), *Plagiochila sharpii* (G2G4), *Plagiochila virginica* var. *virginica* (G3T3), *Plagiomnium carolinianum* (G3), *Platyhypnidium pringlei* (G2G3), *Plethodon aureolus* (G2G3), *Plethodon hubrichti* (G2), *Plethodon punctatus* (G3), *Plethodon welleri* (G3), *Polymnia laevigata* (G3), *Prosartes maculata* (G3G4), *Puma concolor cougar* (G5THQ), *Riccardia jugata* (G2), *Schisandra glabra* (G3), *Scutellaria alabamensis* (G2), *Scutellaria pseudoserrata* (G3), *Scutellaria saxatilis* (G3), *Silene ovata* (G3), *Sorex palustris punctulatus* (G5T3), *Speyeria diana* (G3G4), *Thaspium pinnatifidum* (G2G3), *Trechus luculentus luculentus* (GHTH), *Trillium lancifolium* (G3), *Trillium rugelii* (G3), *Trillium simile* (G3), *Triphora trianthophora* (G3G4), *Viola tripartita* var. *tripartita* (G5T3), *Virginia valerianae pulchra* (G5T3T4)

Environment: These high-diversity deciduous forests occur on deep and enriched soils, usually in somewhat protected landscape positions such as coves or lower slopes.

Vegetation: Dominant tree species include *Acer saccharum*, *Fagus grandifolia*, *Liriodendron tulipifera*, *Tilia americana*, *Quercus rubra*, *Magnolia acuminata*, and *Juglans nigra*. *Tsuga canadensis* may be a component of some stands. The herb layer is very rich, often with abundant spring ephemerals.

SOURCES

References: Braun 1950, Comer et al. 2003, Edinger et al. 2002, Evans 1991, Eyre 1980, Greller 1988**Version:** 20 Aug 2007**Stakeholders:** East, Midwest, Southeast**Concept Author:** M. Pyne and R. Evans**LeadResp:** Southeast

G021. North-Central Beech - Maple - Basswood Forest**CES202.693 NORTH-CENTRAL INTERIOR BEECH-MAPLE FOREST****Primary Division:** Central Interior and Appalachian (202)**Land Cover Class:** Forest and Woodland**Spatial Scale & Pattern:** Large patch**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Upland**National Mapping Codes:** EVT 2313; ESLF 4119; ESP 1313

Concept Summary: This system is found primarily along the southern Great Lakes ranging from central Indiana to southern Ontario. It is typically found on flat to rolling uplands to steep slopes with rich loam soils over glacial till. This system is characterized by a dense tree canopy that forms a thick layer of humus and leaf litter leading to a dense and rich herbaceous layer. *Acer saccharum* and *Fagus grandifolia* comprise up to 80% of the canopy. Other associates can include *Quercus rubra*, *Tilia americana*, *Carpinus caroliniana*, and *Ostrya virginiana*. The relative dominance of sugar maple compared to other tree species varies across the range of this system based on regional climate and microclimate. The herbaceous layer is very diverse and typically includes spring ephemerals. Some common species include *Arisaema triphyllum*, *Osmorhiza claytonii*, *Polygonatum biflorum*, and *Trillium grandiflorum*. The primary natural dynamic influencing this system includes wind-driven gap dynamics. Conversion to agriculture has significantly decreased the range of this system, and very few large stands remain intact.

Comments: North-Central Interior Wet Flatwoods (CES202.700) may co-occur in close proximity to this system on clay-plain landscapes. This is on richer sites than the corresponding Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593).

DISTRIBUTION

Range: This system is located in the southern Great Lakes from central Indiana north into southern Ontario, and east to northwestern Pennsylvania and western New York.

Divisions: 202:C**TNC Ecoregions:** 36:C, 45:C, 47:P, 48:C**Nations:** CA, US**Subnations:** IN, MI, NY, OH, ON, PA**Map Zones:** 47:C, 49:C, 51:C, 52:C, 62:P, 63:C**USFS Ecomap Regions:** 221F:CC, 222H:CC, 222Ia:CCC, 222Ja:CCC, 222Jb:CCC, 222Jc:CCC, 222Je:CCC, 222Jg:CCC, 222Jh:CCC, 222Ji:CCC, 222K:CC, 222L:CC, 222M:CC, 222Ua:CCC, 222Ud:CCC, 222Ue:CCC, 223G:PP, 251D:CC**CONCEPT****Associations:**

- *Acer saccharum* - *Fagus grandifolia* - *Betula* spp. / *Maianthemum canadense* Forest (CEGL005004, G4G5)
- *Fagus grandifolia* - *Acer saccharum* Glaciated Midwest Forest (CEGL005013, G2G3)

High-ranked species: *Myotis sodalis* (G2), *Nicrophorus americanus* (G2G3), *Pieris virginiensis* (G3?), *Rubus variispinus* (G1?Q)

SOURCES

References: Barbour and Billings 1988, Comer and Albert 1997, Comer et al. 1995a, Comer et al. 1998, Comer et al. 2003, Eyre 1980

Version: 20 Jul 2007**Stakeholders:** Canada, East, Midwest, Southeast**Concept Author:** S. Menard**LeadResp:** Midwest**CES202.696 NORTH-CENTRAL INTERIOR MAPLE-BASSWOOD FOREST****Primary Division:** Central Interior and Appalachian (202)**Land Cover Class:** Forest and Woodland**Spatial Scale & Pattern:** Large patch**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Upland**National Mapping Codes:** EVT 2314; ESLF 4120; ESP 1314

Concept Summary: This system is primarily found in the prairie forest border region of Minnesota, Wisconsin, and Iowa, but it can range north into northern Minnesota and Wisconsin and south to central Illinois, central Missouri, and eastern Kansas. This forest system is distinguished by underlying mesic soils and the predominance of mesic deciduous species forming a moderately dense to dense canopy. Examples of this system occur on valley slopes and bottoms often with northern or eastern aspects. Soils are moderately well-drained, fertile, and medium to deep loams that have developed from glacial till or loess parent material. *Acer saccharum* typifies this system, with *Tilia americana*, *Quercus rubra*, and *Ostrya virginiana* as common associates. The dense canopy allows for a rich mixture of shrub and herbaceous species in the understory. Examples of common herbaceous species include *Anemone quinquefolia*, *Adiantum pedatum*, *Arisaema triphyllum*, and *Sanicula* spp. Dynamic processes such as wind and fire can impact this system over long return cycles; however, the most immediate threats to remaining examples of this system are grazing and conversion to agriculture.

Comments: Where *Quercus alba* is prominent in the upper Midwest, this system can be difficult to separate from related oak-dominated systems [see Effigy Mounds NPS map (Hop et al. 2005)]. *Quercus alba* in combination with *Acer saccharum*, and with a more mesic understory, is classified as the present system.

DISTRIBUTION

Range: This system ranges from northern Minnesota and Wisconsin south to eastern Kansas and Nebraska and southeast to central Illinois, Missouri, and possibly western Indiana.

Divisions: 201:C, 202:C, 205:C

TNC Ecoregions: 36:C, 37:C, 38:?, 45:C, 46:C, 47:C, 48:C

Nations: US

Subnations: IA, IL, IN, KS, MI, MN, MO, NE, WI

Map Zones: 39:C, 40:C, 41:C, 42:C, 43:C, 44:P, 49:C, 50:C, 51:C, 52:C

USFS Ecomap Regions: 212J:CP, 212Q:CC, 212S:CP, 212T:CP, 212X:CP, 212Y:C?, 212Z:CP, 222K:CC, 222L:CC, 222M:CC, 222R:CC, 251B:CC, 251G:CC, 251H:CC

CONCEPT

Associations:

- *Acer saccharum* - *Tilia americana* / *Ostrya virginiana* - *Carpinus caroliniana* Forest (CEGL002062, G3G4)
- *Quercus rubra* - (*Acer saccharum*, *Quercus alba*) Forest (CEGL005017, G4?)
- *Acer saccharum* - *Acer nigrum* - *Tilia americana* - *Quercus rubra* / *Ostrya virginiana* Forest (CEGL002061, G3G4)

High-ranked species: *Nicrophorus americanus* (G2G3), *Rubus variispinus* (G1?Q)

Environment: This system is found primarily on mesic soils that are moderately well-drained and fertile. These are mostly moderate to deep loams that have developed from glacial till or loess. This system occurs primarily on valley slopes and bottoms often with northern or eastern aspects.

Vegetation: Mesic deciduous trees form a moderately dense to dense canopy in examples of this system. *Acer saccharum* is the most common tree species forming the majority of the canopy and sapling layers. Common associates include *Tilia americana*, *Quercus rubra*, and *Ostrya virginiana*. The understory contains a rich mixture of shrub and herbaceous species such as *Anemone quinquefolia*, *Adiantum pedatum*, *Arisaema triphyllum*, and *Sanicula* spp. This system is found west and north of where *Fagus grandifolia* is a reliable and dominant member of the canopy.

Dynamics: Wind and fire can impact this system over long return intervals. Small gap development and replacement due to tree death is more frequent than more catastrophic fire or wind. The greatest impacts on this system are due to conversion to agriculture, logging and grazing.

SOURCES

References: Barbour and Billings 1988, Comer et al. 2003, Eyre 1980, Hop et al. 2005, Rolfsmeier and Steinauer 2010

Version: 10 Jul 2009

Stakeholders: Midwest, Southeast

Concept Author: S. Menard and K. Kindscher

LeadResp: Midwest

M159. NORTHERN PINE & OAK - HARDWOOD FOREST

G025. Laurentian & Acadian Pine - Oak Forest & Woodland

CES103.075 LAURENTIAN JACK PINE-RED PINE FOREST

Primary Division: Boreal (103)

Land Cover Class: Forest and Woodland

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

DISTRIBUTION

Divisions: 103:C

Nations: CA, US

Subnations: MI, ON, WI

CONCEPT

Associations:

High-ranked species: *Appalachia arcana* (G2G3), *Erynnis persius persius* (G5T1T3), *Papaipema beeriana* (G2G3), *Plebejus melissa samuelis* (G5T2), *Pyrgus wyandot* (G1G2Q), *Setophaga kirtlandii* (G3G4)

SOURCES

References: Eastern Ecology Working Group n.d., Midwestern Ecology Working Group n.d.

Stakeholders: Canada, Midwest

Concept Author: P. Comer

LeadResp: Midwest

CES201.719 LAURENTIAN-ACADIAN NORTHERN PINE-(OAK) FOREST**Primary Division:** Laurentian-Acadian (201)**Land Cover Class:** Forest and Woodland**Spatial Scale & Pattern:** Matrix**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Upland**Diagnostic Classifiers:** Forest and Woodland (Treed)**National Mapping Codes:** EVT 2362; ESLF 4265; ESP 1362

Concept Summary: This is a pine-dominated, or occasionally pine-oak, forest system that is typically found on nutrient-poor soils, or on moderately rich soils in the upper Midwest, northeastern U.S., and adjacent Canada, in a variety of topographic settings. Soils are loamy to sandy, varying from thin soil over bedrock to deeper soils, sometimes sandy. Sites are xeric to subxeric, but less strongly than barrens and sandplains. The dominant fire regime varies from 100-200 years for *Pinus strobus* and *Pinus resinosa*. Other boreal conifers, or in the East *Picea rubens*, may occasionally be present. Canopy structure is mostly closed but can be partially open. Conifers typically dominate the canopy, but codominates may include hardwoods, especially *Quercus rubra* or *Acer rubrum*, but also *Populus tremuloides* or *Betula papyrifera*. The shrub and field layers can be somewhat dense to sparse.

Comments: This system is dominated by white pine and red pine forests, which are found primarily in the Great Lakes and sub-boreal region, but extend eastward to Acadia. Where *Pinus strobus* is a codominant with *Tsuga canadensis*, stands most typically are placed within Laurentian-Acadian Pine-Hemlock-Hardwood Forest (CES201.563).

DISTRIBUTION**Range:** This system is found in the upper midwestern and northeastern United States and adjacent Canada.**Divisions:** 102:?, 103:?, 201:C**TNC Ecoregions:** 46:?, 47:C, 48:C, 61:C, 63:C**Nations:** CA, US**Subnations:** MB, ME, MI, MN, NB, NH, NS, NY, ON, PA?, PE?, QC, VT, WI**Map Zones:** 41:C, 50:C, 51:C, 63:C, 64:C, 65:C, 66:C

USFS Ecomap Regions: 211A:CP, 211B:CC, 211C:CC, 211D:CC, 211E:CC, 211J:CP, 212Ha:CCC, 212Hb:CCC, 212Hc:CCC, 212Hd:CCC, 212He:CCC, 212Hf:CCC, 212Hg:CCC, 212Hh:CCC, 212Hi:CCC, 212Hj:CCC, 212Hk:CCC, 212Hl:CCC, 212Hm:CCC, 212Jb:CCC, 212Jc:CCC, 212Jo:CCC, 212Ka:CCC, 212Kb:CCC, 212La:CCC, 212Lb:CCC, 212Lc:CCC, 212Ld:CCC, 212Le:CCC, 212Ma:CCC, 212Mb:CCC, 212Na:CCC, 212Nb:CCC, 212Nc:CCC, 212Nd:CCC, 212Qa:CCC, 212Qb:CCC, 212Qc:CCC, 212Qd:CCC, 212Ra:CCC, 212Rb:CCC, 212Rc:CCC, 212Rd:CCC, 212Re:CCC, 212Sb:CCC, 212Sc:CCC, 212Sn:CCC, 212Sq:CCC, 212Ta:CCC, 212Tb:CCC, 212Tc:CCC, 212Te:CCC, 212Tf:CCC, 212Xa:CCC, 212Xb:CCC, 212Xc:CCC, 212Xd:CCC, 212Xe:CCC, 212Xf:CCC, 212Ya:CCC, 212Za:CCC, 212Zb:CCC, 212Zc:CCC, 221Ai:CCC, 221Al:CCC, 222I:CP, 222Ja:CCC, 222Ud:CCC, 222Ue:CCC, M211A:CC, M211Bd:CCC, M211C:CP, M211D:CP

CONCEPT**Associations:**

- *Pinus strobus* / *Vaccinium* spp. Forest (CEGL002444, G3G4)
- *Quercus rubra* - *Acer rubrum* - *Betula* spp. - *Pinus strobus* Semi-natural Forest (CEGL006506, GNA)
- *Pinus strobus* - *Pinus resinosa* / *Cornus canadensis* Forest (CEGL006253, GNR)
- *Pinus strobus* / *Acer spicatum* - *Corylus cornuta* Forest (CEGL002445, G3G4)
- *Pinus resinosa* / *Vaccinium* spp. Forest (CEGL002443, G3)
- *Pinus resinosa* - *Populus tremuloides* / *Diervilla lonicera* - *Vaccinium* spp. Forest (CEGL002520, GNR)
- *Pinus strobus* - *Populus tremuloides* / *Corylus cornuta* Forest (CEGL002479, G4?)
- *Pinus strobus* - (*Pinus resinosa*) - *Quercus rubra* Forest (CEGL002480, G4)
- *Pinus strobus* - *Populus tremuloides* - (*Acer rubrum*) / *Pteridium aquilinum* Forest (CEGL005563, GNA)

High-ranked species: *Botrychium lineare* (G2G3), *Catinella gelida* (G1), *Chilostigma itascae* (G1), *Dubiraphia robusta* (G1G3), *Erynnis persius persius* (G5T1T3), *Fuscoboletinus weaverae* (G1?), *Myotis sodalis* (G2), *Nicrophorus americanus* (G2G3), *Plebejus melissa samuelis* (G5T2), *Pyrgus wyandot* (G1G2Q), *Rubus vagus* (G2?Q), *Somatochlora hineana* (G2G3)

SOURCES

References: Comer et al. 1995a, Comer et al. 1998, Comer et al. 2003, Eyre 1980, Frelich 1992, Gawler and Cutko 2010, Heinselman 1973, Whitney 1986, Whitney 1987

Version: 04 Mar 2004**Stakeholders:** Canada, East, Midwest**Concept Author:** D. Faber-Langendoen and S.C. Gawler**LeadResp:** Midwest**G160. Great Lakes Pine Barrens****CES201.718 LAURENTIAN PINE-OAK BARRENS****Primary Division:** Laurentian-Acadian (201)**Land Cover Class:** Steppe/Savanna

Spatial Scale & Pattern: Matrix

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Woody-Herbaceous

National Mapping Codes: EVT 2407; ESLF 5423; ESP 1407

Concept Summary: These pine-oak barrens occur in the northern and western Great Lakes region. They occur on sandplains/outwash habitats, with dry, frequent fires (every 10-50 years). *Pinus banksiana*, *Pinus resinosa*, *Quercus ellipsoidalis*, and *Pinus strobus* are common overstory dominants. Prairie species are common throughout much of the range of the type. Common shrub and field layer species include *Schizachyrium scoparium*, *Andropogon gerardii*, *Carex pensylvanica*, *Vaccinium angustifolium*, and *Corylus americana*. Oak grubs may be common under frequent burning. Catastrophic burns may create open bracken grasslands.

Comments: This system covers the Great Lakes barrens. The eastern U.S. pine barrens fall into Northeastern Interior Pine Barrens (CES202.590) described under the Central Interior-Appalachian Division (202). The more southern North-Central Oak Barrens (CES202.727) overlaps this type along the "tension zone" of Minnesota and Wisconsin. Northward, this system is differentiated from more boreal systems with *Pinus banksiana* by absence of *Picea mariana* and the presence of many prairie species. Within the pine barrens landscape this system overlaps with Laurentian-Acadian Northern Pine-(Oak) Forest (CES201.719), which may occupy pine barrens sites that have not burned for more than 50 years.

DISTRIBUTION

Range: Occurs in the northern and western Great Lakes region.

Divisions: 201:C

TNC Ecoregions: 45:P, 47:C, 48:C

Nations: CA, US

Subnations: MI, MN, ON, WI

Map Zones: 41:C, 50:C, 51:C

USFS Ecomap Regions: 212Ha:CCC, 212Hb:CCC, 212Hc:CCC, 212He:CCC, 212Hg:CCC, 212Hj:CCC, 212Hk:CCC, 212Hl:CCP, 212J:CP, 212K:CC, 212L:CP, 212N:CC, 212Ra:CCC, 212Rb:CCP, 212Rc:CCP, 212Re:CCP, 212Sc:CCP, 212Sn:CCC, 212Sq:CCP, 212Tb:CCC, 212Tc:CCC, 212Te:CCC, 212X:CP, 222Ja:CCC, 222Jb:CCC, 222R:CC, 222Ud:CCC

CONCEPT

Associations:

- *Pinus banksiana* - (*Pinus resinosa*) - *Quercus ellipsoidalis* / *Carex pensylvanica* Forest (CEGL002478, G4G5)
- *Pinus strobus* - *Quercus alba* - (*Quercus velutina*) / *Andropogon gerardii* Wooded Herbaceous Vegetation (CEGL005127, G2?)
- *Pteridium aquilinum* - *Bromus kalmii* Herbaceous Vegetation (CEGL005142, GNR)
- *Pinus banksiana* - *Pinus resinosa* - (*Quercus ellipsoidalis*) / *Carex pensylvanica* Wooded Herbaceous Vegetation (CEGL005124, G3G4)
- *Quercus ellipsoidalis* - (*Quercus macrocarpa*) Forest (CEGL002077, G4?)
- *Pinus banksiana* - (*Pinus resinosa*) / *Corylus cornuta* Forest (CEGL002442, G4?)
- *Populus tremuloides* - *Quercus (ellipsoidalis, macrocarpa)* / *Andropogon gerardii* Shrubland (CEGL002197, GNR)
- *Pinus banksiana* / *Vaccinium* spp. / *Pleurozium schreberi* Forest (CEGL002441, G4G5)
- *Pinus banksiana* - (*Quercus ellipsoidalis*) / *Schizachyrium scoparium* - Prairie Forbs Wooded Herbaceous Vegetation (CEGL002490, G2)

High-ranked species: *Abagrotis cryptica* (G1G3Q), *Appalachia arcana* (G2G3), *Botrychium* sp. 3 (G3), *Dichagyris reliqua* (G2G3), *Erynnis persius persius* (G5T1T3), *Myotis sodalis* (G2), *Nicrophorus americanus* (G2G3), *Ophiogomphus susbehcha* (G2), *Papaipema beeriana* (G2G3), *Plebejus melissa samuelis* (G5T2), *Pyrgus wyandot* (G1G2Q), *Setophaga kirtlandii* (G3G4), *Somatochlora hineana* (G2G3), *Tachysphex pechumani* (G2G3)

SOURCES

References: Comer et al. 1995a, Comer et al. 1998, Comer et al. 2003, Curtis 1959, Eyre 1980

Version: 05 Mar 2003

Concept Author: D. Faber-Langendoen

Stakeholders: Canada, Midwest

LeadResp: Midwest

M502. APPALACHIAN & NORTHEASTERN OAK - HARDWOOD & PINE FOREST

G015. Appalachian Oak / Chestnut Forest

CES202.359 ALLEGHENY-CUMBERLAND DRY OAK FOREST AND WOODLAND

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Forest and Woodland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Acidic Soil; Broad-Leaved Tree

National Mapping Codes: EVT 2317; ESLF 4123; ESP 1317

Concept Summary: This system encompasses dry hardwood forests on predominately acidic substrates in the Allegheny and Cumberland plateaus, and ridges in the southern Ridge and Valley. Its range is more or less consistent with the "Mixed Mesophytic Forest Region" of Braun (1950) and Greller (1988), although it is not a mesic forest type. These forests are typically dominated by *Quercus alba*, *Quercus falcata*, *Quercus prinus*, *Quercus coccinea*, with lesser amounts of *Acer rubrum*, *Carya glabra*, and *Carya alba*. Small inclusions of *Pinus echinata* and/or *Pinus virginiana* may occur, particularly adjacent to escarpments or following fire. In addition, *Pinus strobus* may be prominent in some stands in the absence of fire. It occurs in a variety of situations, including on nutrient-poor or acidic soils. Sprouts of *Castanea dentata* can often be found where it was formerly a common tree.

Comments: Related forests on more base-rich substrates may be classified as examples of Southern Ridge and Valley / Cumberland Dry Calcareous Forest (CES202.457), where this distinction may be made. Eastward and northward, this system transitions into Central Appalachian Dry Oak-Pine Forest (CES202.591). The dividing line between them is the Allegheny Front.

DISTRIBUTION

Range: This system is centered on the Allegheny and Cumberland plateaus from northern Alabama north to Ohio, West Virginia, and possibly western Pennsylvania.

Divisions: 202:C

TNC Ecoregions: 49:C, 50:C

Nations: US

Subnations: AL, GA, KY, OH, PA?, TN, VA, WV

Map Zones: 48:C, 53:C, 57:C, 61:C, 62:C

USFS Ecomap Regions: 221E:CC, 221H:CC, 221J:CC, 231C:CC, 231D:CC, M221A:CC, M221Ba:CCC, M221Bb:CCC, M221Bc:CCC, M221Be:CCC, M221C:CC

CONCEPT

Associations:

- *Pinus strobus* - *Quercus alba* - (*Carya alba*) / *Gaylussacia ursina* Forest (CEGL007517, G3G4)
- *Quercus alba* - *Quercus velutina* - *Carya* (*ovata*, *alba*, *glabra*) - *Pinus* sp. Forest (CEGL007231, G4G5)
- *Quercus prinus* - (*Quercus coccinea*) / *Carya pallida* / *Vaccinium arboreum* - *Vaccinium pallidum* Forest (CEGL008431, G4G5)
- *Quercus alba* - *Quercus rubra* - *Carya ovata* / *Cercis canadensis* - *Juniperus virginiana* var. *virginiana* Forest (CEGL007240, G4)
- *Quercus alba* - *Carya alba* - (*Quercus velutina*) / *Desmodium nudiflorum* - (*Carex picta*) Forest (CEGL007795, G4)
- *Quercus alba* - *Quercus stellata* / *Ostrya virginiana* - *Acer barbatum* / *Chasmanthium sessiliflorum* Forest (CEGL008443, G3G4)
- *Quercus alba* - (*Quercus prinus*) / (*Hydrangea quercifolia*) - *Viburnum acerifolium* / *Carex picta* - *Piptochaetium avenaceum* Forest (CEGL008430, G3G4)
- *Quercus prinus* - *Quercus rubra* - *Carya* (*ovata*, *glabra*) - *Pinus virginiana* Forest (CEGL007269, G4?)
- *Quercus falcata* - *Quercus alba* - *Carya alba* / *Oxydendrum arboreum* / *Vaccinium stamineum* Forest (CEGL007244, G4G5)
- *Quercus falcata* - *Quercus* (*coccinea*, *stellata*) / *Vaccinium* (*pallidum*, *stamineum*) Forest (CEGL007247, G4)
- *Quercus prinus* - *Quercus* (*alba*, *coccinea*, *velutina*) / *Viburnum acerifolium* - (*Kalmia latifolia*) Forest (CEGL005023, G4?)
- *Quercus alba* - *Quercus* (*coccinea*, *velutina*, *pinus*) / *Gaylussacia baccata* Forest (CEGL008521, G5)
- *Quercus prinus* - *Quercus* spp. / *Vaccinium arboreum* - (*Kalmia latifolia*, *Styrax grandifolius*) Forest (CEGL007700, G4)
- *Quercus prinus* - *Carya* (*alba*, *glabra*, *ovata*) / *Juniperus virginiana* var. *virginiana* Forest (CEGL004786, G2G3)
- *Pinus virginiana* - *Pinus* (*rigida*, *echinata*) - (*Quercus prinus*) / *Vaccinium pallidum* Forest (CEGL007119, G3)
- *Quercus alba* - *Quercus falcata* / *Vaccinium* (*arboreum*, *hirsutum*, *pallidum*) Forest (CEGL008567, G3G4)
- *Pinus rigida* - *Quercus coccinea* / *Vaccinium angustifolium* Woodland (CEGL006557, G4Q)
- *Pinus strobus* - *Quercus* (*coccinea*, *pinus*) / (*Gaylussacia ursina*, *Vaccinium stamineum*) Forest (CEGL007519, G4)
- *Quercus stellata* - *Pinus virginiana* / (*Schizachyrium scoparium*, *Piptochaetium avenaceum*) Woodland (CEGL008406, G2?)
- *Quercus prinus* - *Carya* spp. - *Quercus velutina* / *Vaccinium arboreum* / *Iris verna* var. *smalliana* Forest (CEGL007261, G3G4)

High-ranked species: *Calophrys irus* (G3), *Canis rufus* (G1Q), *Carex communis* var. *amplisquama* (G5T3), *Carex polymorpha* (G3), *Coreopsis delphiniifolia* (G3?Q), *Desmodium ochroleucum* (G1G2), *Fothergilla major* (G3), *Gaylussacia brachycera* (G3), *Lesquerella globosa* (G2), *Melanoplus serrulatus* (G1G3), *Puma concolor cougar* (G5THQ), *Scutellaria montana* (G3), *Taenidia montana* (G3), *Thermopsis fraxinifolia* (G3?), *Thermopsis mollis* (G3G4), *Trillium pusillum* (G3), *Virginia valeriae pulchra* (G5T3T4)

Environment: This system is most likely found on predominantly nutrient-poor or acidic substrates in the Allegheny and Cumberland plateaus, and ridges in the southern Ridge and Valley.

Vegetation: These forests are typically dominated by *Quercus alba*, *Quercus falcata*, *Quercus prinus*, *Quercus coccinea*, *Acer rubrum*, *Carya glabra*, and *Carya alba*. These occur in a variety of situations, most likely on nutrient-poor or acidic soils and, to a much lesser extent, on circumneutral soils. Sprouts of *Castanea dentata* can often be found where it was formerly a common tree. Small inclusions of *Pinus echinata* and/or *Pinus virginiana* may occur, particularly adjacent to escarpments or following fire. In addition, *Pinus strobus* may be prominent in some stands in the absence of fire.

SOURCES

References: Braun 1950, Comer et al. 2003, Evans 1991, Eyre 1980, Greller 1988

CES202.591 CENTRAL APPALACHIAN DRY OAK-PINE FOREST**Primary Division:** Central Interior and Appalachian (202)**Land Cover Class:** Forest and Woodland**Spatial Scale & Pattern:** Matrix**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Upland**Diagnostic Classifiers:** Forest and Woodland (Treed); Ridge/Summit/Upper Slope; Acidic Soil; Pinus (strobis, rigida, echinata, virginiana) - Quercus prinus**National Mapping Codes:** EVT 2369; ESLF 4312; ESP 1369

Concept Summary: These oak and oak-pine forests cover large areas in the low- to mid-elevation Central Appalachians and middle Piedmont. The topography and landscape position range from rolling hills to steep slopes, with occasional occurrences on more level, ancient alluvial fans. In the highly dissected fall zone of Maryland and the District of Columbia, where the Piedmont and Coastal Plain meet, it is also found on dry knolls capped with Pleistocene- and Tertiary-aged fluvial cobble and gravel terrace deposits. Soils are typically coarse and infertile; they may be deep (on glacial deposits in the northern and terrace deposits in the southern parts of the system's range), or more commonly shallow, on rocky slopes of acidic rock (shale, sandstone, other acidic igneous or metamorphic rock). The well-drained soils and exposure create dry conditions. The forest is mostly closed-canopy but can include patches of more open woodlands. It is dominated by a variable mixture of dry-site oak and pine species, most typically *Quercus prinus*, *Pinus virginiana*, and *Pinus strobus*, but sometimes *Quercus alba* and/or *Quercus coccinea*. The system may include areas of oak forest, pine forest (usually small), and mixed oak-pine forest. Heath shrubs such as *Vaccinium pallidum*, *Gaylussacia baccata*, and *Kalmia latifolia* are common in the understory and often form a dense layer. Embedded submesic ravines and concave landforms support slightly more diverse forests characterized by mixtures of oaks, several hickories, *Cornus florida*, and sometimes *Liriodendron tulipifera*. Small hillslope pockets with impeded drainage may support small isolated wetlands with *Acer rubrum* and *Nyssa sylvatica* characteristic. Disturbance agents include fire, windthrow, and ice damage. Increased site disturbance generally leads to secondary forest vegetation with a greater proportion of *Pinus virginiana* and weedy hardwoods such as *Acer rubrum*.

Comments: This system occurs in drier settings than the other matrix oak forest system of the division, Northeastern Interior Dry-Mesic Oak Forest (CES202.592), except in New York and New England, which are mostly out of the range of CES202.592. In that system, *Quercus rubra*, *Quercus alba*, *Quercus velutina*, and/or *Quercus coccinea* and *Carya* spp. are the typical dominants rather than *Quercus prinus*. It includes the system formerly segregated as Southern Piedmont Dry Oak-Heath Forest (CES202.023). Its analog from central Virginia south is Southern Piedmont Dry Oak-(Pine) Forest (CES202.339), which has somewhat more southern floristics, for example, the typical presence of *Pinus taeda*.

DISTRIBUTION

Range: This system is found from central New England through Pennsylvania and south to the Roanoke River in southern Virginia. It is primarily Appalachian but overlaps slightly into the upper Piedmont and fall zone in Virginia, Maryland and the District of Columbia.

Divisions: 202:C**TNC Ecoregions:** 52:C, 58:C, 59:C, 60:C, 61:C**Nations:** US**Subnations:** CT, DC, MA, MD, ME, NH, NJ, NY, OH, PA, RI, VA, VT, WV**Map Zones:** 57:P, 60:C, 61:C, 63:C, 64:C, 65:C, 66:C**USFS Ecomap Regions:** 211E:CC, 211F:CC, 211G:CC, 211I:CC, 221A:CC, 221B:CC, 221D:CC, 232A:CC, M221A:CC, M221Ba:CCC, M221Bb:CCC, M221Bd:CCC, M221Bf:CCC, M221Da:CCC**CONCEPT****Associations:**

- *Castanea dentata* - *Quercus prinus* Forest (CEGL007196, GX)
- *Quercus prinus* / *Rhododendron catawbiense* - *Kalmia latifolia* Forest (CEGL008524, G4)
- *Quercus prinus* - *Quercus rubra* / *Vaccinium pallidum* - (*Rhododendron periclymenoides*) Forest (CEGL008523, G3G4)
- *Quercus (velutina, alba)* / *Vaccinium pallidum* High Allegheny Plateau, Western Allegheny Plateau Forest (CEGL006018, GNR)
- *Quercus (alba, rubra, velutina)* - *Carya* spp. / *Viburnum acerifolium* Forest (CEGL006336, G4G5)
- *Quercus alba* - *Quercus (coccinea, velutina, prinus)* / *Gaylussacia baccata* Forest (CEGL008521, G5)
- *Pinus strobus* - *Pinus resinosa* - *Pinus rigida* Forest (CEGL006259, G4G5)
- *Acer saccharum* - *Quercus muehlenbergii* / *Carex platyphylla* Forest (CEGL006162, GNR)
- *Pinus strobus* - *Quercus (rubra, velutina)* - *Fagus grandifolia* Forest (CEGL006293, G5)
- *Tsuga canadensis* - *Quercus prinus* - *Betula lenta* Forest (CEGL006923, G3)
- *Quercus (rubra, velutina, alba)* - *Betula lenta* - (*Pinus strobus*) Forest (CEGL006454, G4G5)
- *Pinus virginiana* - *Pinus (rigida, echinata)* - (*Quercus prinus*) / *Vaccinium pallidum* Forest (CEGL007119, G3)
- *Quercus alba* - *Quercus prinus* - *Carya glabra* / *Cornus florida* / *Vaccinium pallidum* Forest (CEGL008515, G4)

- *Fagus grandifolia* - *Betula lenta* - *Quercus* (*alba*, *rubra*) / *Carpinus caroliniana* Forest (CEGL006921, GNR)
- *Pinus rigida* - *Quercus* (*velutina*, *prinus*) Forest (CEGL006290, GNR)
- *Quercus prinus* - (*Quercus coccinea*, *Quercus rubra*) / *Kalmia latifolia* / *Vaccinium pallidum* Forest (CEGL006299, G5)
- *Quercus prinus* - *Quercus* (*rubra*, *velutina*) / *Vaccinium* (*angustifolium*, *pallidum*) Forest (CEGL006282, G5)
- *Pinus strobus* - *Quercus alba* - *Quercus prinus* / *Vaccinium stamineum* Forest (CEGL008539, G4)
- *Pinus* (*pungens*, *rigida*) - *Quercus prinus* / (*Quercus ilicifolia*) / *Gaylussacia baccata* Woodland (CEGL004996, G4)

High-ranked species: *Callophrys irus* (G3)

Environment: These oak and oak-pine forests cover large areas in the low- to mid-elevation central Appalachians and middle Piedmont. The topography and landscape position range from rolling hills to steep slopes, with occasional occurrences on more level, ancient alluvial fans. The soils are coarse and infertile; they may be deep (on glacial deposits in the northern part of the system's range), or more commonly shallow, on rocky slopes of acidic rock (shale, sandstone, other acidic igneous or metamorphic rock). The well-drained soils and exposure create dry conditions. In the highly dissected fall zone of Maryland and the District of Columbia, where the Piedmont and Coastal Plain meet, it is also found on dry knolls capped with Pleistocene- and Tertiary-aged fluvial cobble and gravel terrace deposits.

Vegetation: Stands of this forest system are mostly closed-canopied but can include more open woodlands. They are dominated by a variable mixture of dry-site oak and pine species, including *Quercus prinus*, *Pinus virginiana*, and *Pinus strobus*. The system may include areas of pine forest and mixed oak-pine forest. Heath shrubs such as *Vaccinium pallidum*, *Gaylussacia baccata*, and *Kalmia latifolia* are common in the understory. Within these forests, hillslope pockets with impeded drainage may support small isolated wetlands with *Acer rubrum* and *Nyssa sylvatica* characteristic.

Dynamics: Disturbance agents include fire, windthrow, and ice damage.

SOURCES

References: Comer et al. 2003, Eyre 1980, Gawler and Cutko 2010, LNVDD 2007

Version: 23 Jan 2012

Concept Author: S.C. Gawler

Stakeholders: East, Southeast

LeadResp: East

G161. Pitch Pine Barrens

CES202.600 CENTRAL APPALACHIAN PINE-OAK ROCKY WOODLAND

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Forest and Woodland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Forest and Woodland (Treed); Shrubland (Shrub-dominated); Woody-Herbaceous; Ridge/Summit/Upper Slope; Acidic Soil; *Pinus* (*strobus*, *rigida*, *echinata*, *virginiana*) - *Quercus prinus*

National Mapping Codes: EVT 2377; ESLF 4320; ESP 1377

Concept Summary: This system encompasses open or patchily wooded hilltops and outcrops or rocky slopes in the Central Appalachians, High Allegheny Plateau, and Lower New England / Northern Piedmont. It occurs mostly at lower elevations, but occasionally up to 1220 m (4000 feet) in West Virginia. The substrate rock is generally granitic or of other acidic lithology, although near the northern limit of its range in New England, examples can also occur on intermediate, base-rich, or mafic bedrock including traprock. The vegetation is patchy, with woodland as well as open portions. *Pinus rigida* (and within its range *Pinus virginiana*) is diagnostic and often mixed with xerophytic *Quercus* spp. and sprouts of *Castanea dentata*. In New England, some examples lack pine and feature *Juniperus virginiana* or *Ostrya virginiana* as important codominants with oak. Some areas have a fairly well-developed heath shrub layer, others a graminoid layer, the latter particularly common under oaks or other deciduous trees. Conditions are dry and for the most part nutrient-poor, and at many, if not most, sites, a history of fire is evident. In the Central Appalachians ecoregion, this system is rarely found on sandy soils rather than rock.

Comments: The northern extent of this system in central New England may overlap with Northern Appalachian-Acadian Rocky Heath Outcrop (CES201.571), which has *Picea* spp. prominent. The southern extent overlaps with Southern Appalachian Montane Pine Forest and Woodland (CES202.331), which is characterized by *Pinus pungens*. The present type may have some *Pinus pungens* (from southern Pennsylvania south) but generally has other pines as well. This type is differentiated from the similar Central Appalachian Dry Oak-Pine Forest (CES202.591) by its mosaic nature of wooded and open patches, as opposed to being merely a "thin forest." New England dry-rich forest/woodlands (e.g., those on traprock ridges) are also housed here, expanding the concept beyond pitch pine diagnostics. Pike Knob, West Virginia, with its disjunct red pine woodlands, is put into this system.

DISTRIBUTION

Range: This system occurs from central New England south to Virginia and West Virginia, with peripheral occurrences in southeastern Ohio and easternmost Kentucky.

Divisions: 202:C

TNC Ecoregions: 49:C, 50:C, 52:C, 59:C, 60:C, 61:C, 64:C

Nations: US

Subnations: CT, KY, MA, MD?, ME, NH, NJ, NY, OH, PA, VA, VT, WV

Map Zones: 53:C, 57:P, 60:C, 61:C, 62:C, 63:C, 64:C, 65:C, 66:C

USFS Ecomap Regions: 211E:CC, 211F:CC, 221A:CC, 221B:CC, M211Bb:CCC, M211Bd:CCC, M211C:CC, M221A:CC, M221B:CP

CONCEPT

Associations:

- *Schizachyrium scoparium* - *Danthonia spicata* - *Carex pensylvanica* / *Cladonia* spp. Herbaceous Vegetation (CEGL006544, G3)
- *Vaccinium angustifolium* - *Sorbus americana* / *Sibbaldiopsis tridentata* Dwarf-shrubland (CEGL005094, GNR)
- *Pinus rigida* / (*Quercus ilicifolia*) / *Photinia melanocarpa* / *Deschampsia flexuosa* Woodland (CEGL006116, G4)
- *Quercus rubra* - (*Quercus prinus*) / *Vaccinium* spp. / *Deschampsia flexuosa* Woodland (CEGL006134, G4)
- *Quercus prinus* - *Pinus virginiana* - (*Pinus pungens*) / *Schizachyrium scoparium* - *Dichanthelium depauperatum* Woodland (CEGL008540, G3?)
- *Pinus rigida* / *Corema conradii* Woodland (CEGL006154, G2)
- *Penstemon hirsutus* Sparse Vegetation (CEGL006535, GNR)
- *Vaccinium* (*angustifolium*, *myrtilloides*, *pallidum*) Central Appalachian Dwarf-shrubland (CEGL003958, G3G4)
- *Kalmia latifolia* - *Gaylussacia baccata* - *Vaccinium* (*angustifolium*, *pallidum*) - *Menziesia pilosa* Shrubland (CEGL003939, G2)
- *Quercus prinus* / *Rhus* spp. / *Deschampsia flexuosa* Woodland (CEGL006074, G3)
- *Pinus virginiana* - *Pinus* (*rigida*, *echinata*) - (*Quercus prinus*) / *Vaccinium pallidum* Forest (CEGL007119, G3)
- *Pinus resinosa* / *Menziesia pilosa* / *Polypodium appalachianum* Forest (CEGL006108, G1)
- *Juniperus virginiana* - *Fraxinus americana* / *Danthonia spicata* - *Poa compressa* Woodland (CEGL006002, G3)
- *Pinus rigida* - *Quercus coccinea* / *Vaccinium angustifolium* Woodland (CEGL006557, G4Q)
- *Pinus rigida* / *Gaylussacia baccata* Shrubland (CEGL006079, G1)
- *Photinia melanocarpa* - *Gaylussacia baccata* / *Carex pensylvanica* Shrubland (CEGL008508, G1?)
- *Quercus ilicifolia* - *Prunus pumila* Shrubland (CEGL006121, G4?)
- *Quercus prinus* / *Quercus ilicifolia* / *Danthonia spicata* Woodland (CEGL008526, G3?)
- *Quercus rubra* - *Carya* (*glabra*, *ovata*) / *Ostrya virginiana* / *Carex lucorum* Forest (CEGL006301, G4)
- *Pinus* (*pungens*, *rigida*) - *Quercus prinus* / (*Quercus ilicifolia*) / *Gaylussacia baccata* Woodland (CEGL004996, G4)

High-ranked species: *Arabis serotina* (G2), *Canis rufus* (G1Q), *Carex polymorpha* (G3), *Catocala herodias gerhardi* (G3T3), *Gaylussacia brachycera* (G3), *Malaxis bayardii* (G1G2), *Packeria millefolia* (G2), *Puma concolor cougar* (G5THQ), *Pyrgus wyandot* (G1G2Q), *Taenidia montana* (G3), *Vaccinium hirsutum* (G3), *Virginia valeriae pulchra* (G5T3T4)

Environment: This system occurs mostly at lower elevations, but occasionally up to 1220 m (4000 feet) in West Virginia. The substrate rock is generally granitic or of other acidic lithology, although near the northern limit of its range in New England, examples can also occur on intermediate, base-rich, or mafic bedrock including traprock. This system contains species-poor, fire-influenced, mixed woodlands of xeric, exposed montane habitats. They are typically located on convex, south to west facets of steep spur ridges, narrow rocky crests, and cliff tops. Pine - oak / heath woodlands are widespread throughout both the Ridge and Valley and Blue Ridge provinces in western Virginia. They occur at elevations from below 305 m (1000 feet) to more than 1220m (4000 feet) on various substrates, but most commonly on acidic, sedimentary and metasedimentary substrates, e.g., sandstone, quartzite, and shale. A few stands occur on Piedmont monadnocks and foothills. Soils are very infertile, shallow, and droughty (VDNH 2007). The type is restricted to poor, dry sites which have been disturbed in the recent past by heavy cutting, fire, or both. It is found on thin, rocky soils in the mountainous areas. Soils are strongly acidic and devoid of nutrients. Precipitation is low in the shale barrens of eastern West Virginia and adjacent states (Eyre 1980).

Vegetation: Short-statured *Pinus pungens* and *Pinus rigida* are usually the dominants forming an open overstory, often with codominant *Quercus prinus* (= *Quercus montana*). Less important tree associates include *Quercus coccinea*, *Pinus virginiana*, and *Sassafras albidum*. Except in the Piedmont, *Quercus ilicifolia* is characteristically abundant in the shrub layer, along with various ericaceous species. Colonial shrubs usually preempt available microhabitats for most herbaceous species, but *Pteridium aquilinum* var. *latiusculum* and *Xerophyllum asphodeloides* are often competitive enough to achieve significant cover (VDNH 2007). The globally rare *Carex polymorpha*, the state-rare northern pine snake (*Pituophis melanoleucus melanoleucus*) and several rare moths, all bear oak feeders, are locally associated with these woodlands. More common and conspicuous animals often found in these dry, rocky, semi-open habitats include the northern fence lizard (*Sceloporus undulatus hyacinthinus*) and the five-lined skink (*Eumeces fasciatus*) (VDNH 2007).

Dynamics: Periodic fire is an important ecological process that provides opportunities for regeneration of both pines and less competitive herbaceous species, while setting back successional encroachment of potential overstory oaks (especially chestnut oak). On cliffs and other very rocky sites, the vegetation is self-perpetuating due to extreme edaphic conditions. (VDNH 2007). Fire is the most common disturbance type, but frost pockets and late-spring frosts have been also documented. If disturbances occur very frequently (every 2-3 years), *Quercus ilicifolia* may be replaced by low shrubs, grasses, ferns, and other herbs. If disturbances are infrequent, canopy trees can outgrow the shade-intolerant *Quercus ilicifolia*.

SOURCES

References: Comer et al. 2003, Eyre 1980, Fleming et al. 2005, Gawler and Cutko 2010, LNVDD 2007, Metzler and Barrett 2006, Sperduto 2005, VDNH 2007

G162. Virginia Pine & Table Mountain Pine Woodland & Barrens**CES202.331 SOUTHERN APPALACHIAN MONTANE PINE FOREST AND WOODLAND****Primary Division:** Central Interior and Appalachian (202)**Land Cover Class:** Forest and Woodland**Spatial Scale & Pattern:** Large patch**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Upland**Diagnostic Classifiers:** Montane; Forest and Woodland (Treed); Needle-Leaved Tree**National Mapping Codes:** EVT 2352; ESLF 4255; ESP 1352

Concept Summary: This system consists of predominantly evergreen woodlands (or more rarely forests) occupying very exposed, convex, often rocky south- and west-facing slopes, ridge spurs, crests, and clifftops in the Central Appalachians, Southern Ridge and Valley and Southern Blue Ridge. They occur at moderate to upper elevations (450-1200 m [1500-4000 feet]), with the more southerly examples at the higher elevations. In the Southern Blue Ridge, this system is best developed above 700 m (2300 feet) in elevation. The underlying rock is acidic and sedimentary or metasedimentary (e.g., quartzites, sandstones and shales). The soils are very infertile, shallow and droughty. A thick, poorly decomposed duff layer, along with dead wood and highly volatile ericaceous shrubs, creates a strongly fire-prone habitat. Most examples are dominated by *Pinus pungens*, often with *Pinus rigida* and/or *Pinus virginiana*, and occasionally *Tsuga caroliniana*. The canopy is usually patchy to open, but areas of closed canopy may be present, especially where *Tsuga caroliniana* is prominent. Fire is a very important ecological process in this system. Pines may be able to maintain dominance due to edaphic conditions, such as very shallow soil or extreme exposure in some areas which can produce sustained drought conditions, but most sites appear eventually to succeed to oak dominance in the absence of fire. Fire is also presumably a strong influence on vegetation structure, producing a more open woodland canopy structure and more herbaceous ground cover.

Comments: This system is related to Central Appalachian Pine-Oak Rocky Woodland (CES202.600), which is distinguished by a mixed or deciduous canopy and absence of *Pinus pungens*. Stands with *Pinus echinata* present are generally accommodated by Southern Appalachian Low-Elevation Pine Forest (CES202.332). The relationship between these two systems may need further clarification. This system is distinguished by occurrence as small patches on the most extreme topography, as well as by the species of pines dominating. However, *Pinus echinata* may codominate in Southern Appalachian Low-Elevation Pine Forest (CES202.332) at times. Sites that would support this system under a natural fire regime, but which have lost the pines by logging, southern pine beetle or senescence in the absence of fire, should probably be regarded as degraded examples of this system. However, they become virtually indistinguishable from Southern Appalachian Oak Forest (CES202.886) and Central Appalachian Pine-Oak Rocky Woodland (CES202.600) over time.

DISTRIBUTION

Range: This system is centered on the Southern Blue Ridge, from northern Georgia and South Carolina north through Virginia, with outlying occurrences north through the Central Appalachians to a small incursion in the northern Blue Ridge of south-central Pennsylvania.

Divisions: 202:C**TNC Ecoregions:** 49:C, 50:C, 51:C, 52:C, 59:C**Nations:** US**Subnations:** GA, KY, MD, NC, OH, PA, SC, TN, VA, WV**Map Zones:** 53:C, 54:C, 57:C, 59:C, 60:C, 61:C**USFS Ecomap Regions:** M221D:CC**CONCEPT****Associations:**

- *Pinus rigida* - (*Pinus pungens*) / *Rhododendron catawbiense* - *Kalmia latifolia* / *Galax urceolata* Woodland (CEGL004985, G2)
- *Pinus pungens* - *Pinus rigida* - (*Quercus prinus*) / *Kalmia latifolia* - *Vaccinium pallidum* Woodland (CEGL007097, G3)
- *Tsuga caroliniana* - *Pinus (rigida, pungens, virginiana)* Forest (CEGL006178, G2)
- *Tsuga caroliniana* / *Kalmia latifolia* - *Rhododendron catawbiense* Forest (CEGL007139, G2)
- *Pinus virginiana* - *Pinus (rigida, echinata)* - (*Quercus prinus*) / *Vaccinium pallidum* Forest (CEGL007119, G3)
- *Pinus rigida* / *Schizachyrium scoparium* - *Sorghastrum nutans* - *Baptisia tinctoria* Woodland (CEGL003617, G2?)

High-ranked species: *Canis rufus* (G1Q), *Carex polymorpha* (G3), *Catocala herodias gerhardi* (G3T3), *Cicindela patrulea* (G3), *Erynnis martialis* (G3), *Gaylussacia brachycera* (G3), *Microtus chrotorrhinus carolinensis* (G4T3), *Neotoma magister* (G3G4), *Plethodon punctatus* (G3), *Puma concolor cougar* (G5THQ), *Pyrgus wyandot* (G1G2Q), *Tsuga caroliniana* (G3), *Virginia valeriana pulchra* (G5T3T4)

Environment: This system occurs on ridgetops, usually only on the sharpest and narrowest spur ridges, and adjacent convex upper slopes. These sites are the extreme of convex landforms. Rapid drainage of rainfall and exposure to wind, sun and lightning are

probably the important characteristics. Bedrock may be of any acidic type, including felsic igneous and metamorphic rocks, sandstone and quartzite. Soils are shallow and rocky residual soils. Fire appears to be an important factor.

Vegetation: Vegetation consists of open forests or woodlands dominated by *Pinus pungens*, often with *Pinus rigida* or less commonly *Tsuga caroliniana*, and sometimes with *Pinus virginiana* or rarely *Pinus echinata* codominant. In examples that have not had fire in a long time, *Quercus prinus*, *Quercus coccinea*, or other oaks are usually present and are sometimes abundant, as are *Nyssa sylvatica* and *Acer rubrum*. *Castanea dentata* may also have once been abundant. A dense heath shrub layer is almost always present. *Kalmia latifolia* is the most typical dominant, but species of *Rhododendron*, *Vaccinium*, or *Gaylussacia* may be dominant. Herbs are usually sparse but probably were more abundant and shrubs less dense when fires occurred more frequently.

Dynamics: Fire is apparently a very important process in this system (Harrod and White 1999). Pines may be able to maintain dominance due to shallow soils and extreme exposure in some areas, but most sites appear eventually to succeed to oak dominance in the absence of fire. Fire is also presumably a strong influence on vegetation structure, producing a more open woodland canopy structure and more herbaceous ground cover. Occurrence in highly exposed sites may make this system more prone to ignition, but most fires probably spread from adjacent oak forests. Fires could be expected to show more extreme behavior in this system than in oak forests under similar conditions, due to the flammability of the vegetation and the dry, windy and steep location. Both intense catastrophic fires and lower-intensity fires probably occurred naturally. Natural occurrences probably include both even-aged and uneven-aged canopies. Southern pine beetles are an important factor in this system, at least under present conditions. Beetle outbreaks can kill all the pines without creating the conditions for the pines to regenerate. If the pines are lost, the distinction between this system and Southern Appalachian Oak Forest (CES202.886) or Central Appalachian Pine-Oak Rocky Woodland (CES202.600) becomes blurred.

SOURCES

References: Comer et al. 2003, Evans 1991, Eyre 1980, Harrod and White 1999

Version: 05 May 2008

Concept Author: M. Schafale, R. Evans, M. Pyne, R. White

Stakeholders: East, Midwest, Southeast

LeadResp: Southeast

G650. Northeastern Oak - Hickory Forest & Woodland

CES202.592 NORTHEASTERN INTERIOR DRY-MESIC OAK FOREST

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Forest and Woodland

Spatial Scale & Pattern: Matrix

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland

Diagnostic Classifiers: Lowland; Forest and Woodland (Treed); Acidic Soil; Quercus - Carya

National Mapping Codes: EVT 2303; ESLF 4109; ESP 1303

Concept Summary: These oak-dominated forests are one of the matrix forest systems in the northeastern and north-central U.S. Occurring in dry-mesic settings, they are typically closed-canopy forests, though there may be areas of patchy-canopy woodlands. They cover large expanses at low to mid elevations, where the topography is flat to gently rolling, occasionally steep. Soils are mostly acidic and relatively infertile but not strongly xeric. Local areas of calcareous bedrock, or colluvial pockets, may support forests typical of richer soils. Oak species characteristic of dry-mesic conditions (e.g., *Quercus rubra*, *Quercus alba*, *Quercus velutina*, and *Quercus coccinea*) and *Carya* spp. are dominant in mature stands. *Quercus prinus* may be present but is generally less important than the other oak species. *Castanea dentata* was a prominent tree before chestnut blight eradicated it as a canopy constituent. *Acer rubrum*, *Betula lenta*, and *Betula alleghaniensis* may be common associates; *Acer saccharum* is occasional. With a long history of human habitation, many of the forests are early- to mid-successional, where *Pinus strobus*, *Pinus virginiana*, or *Liriodendron tulipifera* may be dominant or codominant. Within these forests, hillslope pockets with impeded drainage may support small isolated wetlands, including non-forested seeps or forested wetlands with *Acer rubrum*, *Quercus bicolor*, or *Nyssa sylvatica* characteristic.

Comments: The oak-dominated forest matrix in this region spans a range of elevational and moisture regimes, reflected in different ecological systems. Those in drier settings, within the general range of this system, are placed in either Allegheny-Cumberland Dry Oak Forest and Woodland (CES202.359) or Central Appalachian Dry Oak-Pine Forest (CES202.591).

DISTRIBUTION

Range: This system is found from southern New York west through Ohio and Pennsylvania and south to Virginia. It does not extend to the southernmost part of Virginia, except in the Ridge and Valley.

Divisions: 202:C

TNC Ecoregions: 49:C, 52:C, 59:C, 60:C, 61:C

Nations: US

Subnations: MD, NJ, NY, OH, PA, VA, WV

Map Zones: 53:C, 57:C, 60:C, 61:C, 62:C, 63:C, 64:C

USFS Ecomap Regions: 211E:CC, 211F:CC, 211G:CC, 221A:CC, 221B:CC, 221D:CC, 221F:CC, M221A:CC, M221B:CC, M221Da:CCC

CONCEPT

Associations:

- *Quercus alba* - *Quercus rubra* - *Carya ovata* Glaciated Forest (CEGL002068, G4?)
- *Quercus* (*alba*, *rubra*, *velutina*) - *Carya* spp. / *Viburnum acerifolium* Forest (CEGL006336, G4G5)
- *Quercus alba* - *Quercus rubra* - *Carya alba* / *Cornus florida* / *Vaccinium stamineum* / *Desmodium nudiflorum* Piedmont Forest (CEGL008475, G4G5)
- *Quercus muehlenbergii* - *Quercus* (*alba*, *rubra*) - *Carya cordiformis* / *Viburnum prunifolium* Forest (CEGL004793, G3G4)
- *Pinus strobus* - *Quercus* (*rubra*, *velutina*) - *Fagus grandifolia* Forest (CEGL006293, G5)
- *Quercus rubra* - *Carya* (*glabra*, *ovata*) / *Ostrya virginiana* / *Carex lucorum* Forest (CEGL006301, G4)
- *Quercus prinus* - *Quercus rubra* - *Carya ovalis* / *Carex pensylvanica* - (*Calamagrostis porteri*) Forest (CEGL008516, G3G4)
- *Quercus* (*rubra*, *velutina*, *alba*) - *Betula lenta* - (*Pinus strobus*) Forest (CEGL006454, G4G5)
- *Quercus alba* - *Quercus rubra* - *Carya* (*alba*, *ovata*) / *Cornus florida* Acidic Forest (CEGL002067, G3)
- *Quercus alba* - *Quercus rubra* - *Quercus prinus* - *Acer saccharum* / *Lindera benzoin* Forest (CEGL002059, GNR)
- *Quercus rubra* - *Carya* (*ovata*, *ovalis*) - *Fraxinus americana* / *Actaea racemosa* - *Hydrophyllum virginianum* Forest (CEGL008518, G3G4)
- *Quercus bicolor* / *Vaccinium corymbosum* / *Carex stipata* Forest (CEGL006241, GNR)
- *Quercus rubra* - *Quercus prinus* - *Carya ovalis* / (*Cercis canadensis*) / *Solidago* (*caesia*, *curtisii*) Forest (CEGL008514, G3G4)
- *Liriodendron tulipifera* - *Pinus strobus* - *Tsuga canadensis* - *Quercus* (*rubra*, *alba*) / *Polystichum acrostichoides* Forest (CEGL006304, G4?)
- *Quercus rubra* - *Acer saccharum* / *Ostrya virginiana* / *Cardamine concatenata* Forest (CEGL008517, G4)
- *Fagus grandifolia* - *Betula lenta* - *Quercus* (*alba*, *rubra*) / *Carpinus caroliniana* Forest (CEGL006921, GNR)
- *Quercus prinus* - *Quercus rubra* / *Hamamelis virginiana* Forest (CEGL006057, G5)
- *Tilia americana* - *Fraxinus americana* / *Acer pensylvanicum* - *Ostrya virginiana* / *Parthenocissus quinquefolia* - *Impatiens pallida* Woodland (CEGL008528, G3)
- *Quercus alba* - *Carya glabra* - *Fraxinus americana* / *Cercis canadensis* / *Muhlenbergia sobolifera* - *Elymus hystrix* Forest (CEGL006216, G3)

High-ranked species: *Calophrys irus* (G3), *Canis rufus* (G1Q), *Carex communis* var. *amplisquama* (G5T3), *Carex polymorpha* (G3), *Coreopsis delphinifolia* (G3?Q), *Fothergilla major* (G3), *Gaylussacia brachycera* (G3), *Melanoplus serrulatus* (G1G3), *Puma concolor cougar* (G5THQ), *Taenidia montana* (G3), *Thermopsis fraxinifolia* (G3?), *Thermopsis mollis* (G3G4), *Virginia valeriana pulchra* (G5T3T4)

Environment: These oak-dominated forests are one of the matrix forest systems in the northeastern and north-central U.S. Occurring in dry-mesic settings, they are typically closed-canopy forests, though there may be areas of patchy-canopy woodlands. They cover large expanses at low to mid elevations, where the topography is flat to gently rolling, occasionally steep. The typical landscape position is midslope to toeslope, transitioning to more xeric systems on the upper slopes and ridges. Soils are acidic and relatively infertile but not strongly xeric.

Vegetation: Mature stands are dominated by oak species characteristic of dry-mesic conditions (e.g., *Quercus rubra*, *Quercus alba*, *Quercus velutina*, and *Quercus coccinea*), along with various *Carya* spp. *Quercus prinus* may be present but is generally less important than the other oak species. *Castanea dentata* was a prominent tree before chestnut blight eradicated it as a canopy constituent. *Acer rubrum* and *Betula lenta* are frequently common associates. Local areas of calcareous bedrock may support forests typical of richer soils (e.g., with *Acer saccharum* and/or *Quercus muehlenbergii*). Common shrubs include *Viburnum acerifolium*, *Hamamelis virginiana*, *Corylus* spp., and *Smilax* spp., as well as heaths such as *Kalmia latifolia*, *Vaccinium* spp., and *Gaylussacia* spp. Herbs, forbs, and ferns are usually sparse to moderate in density.

Dynamics: This system is naturally dominated by stable, uneven-aged forests, with canopy dynamics dominated by gap-phase regeneration. Most oaks are long-lived, with typical age of mortality ranging from 200 to 400 years. *Quercus coccinea* and *Quercus velutina* are shorter-lived with typical ages being approximately 50 to 100 years, while *Quercus alba* can live as long as 600 years. Extreme wind or ice storms occasionally create larger canopy openings. This forest system is characterized by low-severity surface fires that cause variable structure and composition based on fire frequency and intensity. The great majority of historical fires were generated by Native Americans. Open woodlands developed within a moderate burning regime, (fire-return intervals of 5 to 15 years), and canopy closure occurred with greater fire-return intervals. Shade-tolerant, fire-sensitive trees such as *Acer saccharum* regenerated beneath oak-hickory canopies when fire was excluded over several decades. With continued fire exclusion, *Acer saccharum* and other late-successional species gradually replaced overstory oaks and hickories as forest gaps closed (Sutherland et al. 2003), generating a mosaic of vegetation types formed with varying fire history (Cutter and Guyette 1994). A recent study on fire history of a *Quercus rubra* stand in West Virginia revealed that fire intervals ranged from 7 to 32 years from 1846 to 2002, in contrast to intervals of 7 to 15 years prior to the fire control era. These results were consistent with previous research in the oak forests of Ohio, Maryland, and Missouri (Schuler and McClain 2003).

SOURCES

References: Braun 1950, Comer et al. 2003, Cutter and Guyette 1994, Eyre 1980, Greller 1988, LNVDD 2007, Schuler and McClain 2003, Sutherland et al. 2003, USFS 1995, Vanderhorst and Streets 2006

Version: 23 Jan 2012

Stakeholders: East, Midwest, Southeast

1.B.3. TEMPERATE FLOODED & SWAMP FOREST

1.B.3.Na. Eastern North American Flooded & Swamp Forest

M029. NORTHERN & CENTRAL FLOODPLAIN FOREST

G652. Silver Maple - Green Ash - Sycamore - Hackberry Floodplain Forest

CES202.694 NORTH-CENTRAL INTERIOR FLOODPLAIN

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Mixed Upland and Wetland

Spatial Scale & Pattern: Linear

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland

Concept Summary: This system is found along rivers across the glaciated Midwest. It occurs from river's edge across the floodplain or to where it meets a wet meadow system. It can have a variety of soil types found within the floodplain from very well-drained sandy substrates to very dense clays. It is this variety of substrates and flooding that creates the mix of vegetation that includes *Acer saccharinum*, *Populus deltoides*, willows, especially *Salix nigra* in the wettest areas, and *Fraxinus pennsylvanica*, *Ulmus americana*, and *Quercus macrocarpa* in more well-drained areas. Within this system are oxbows that may support *Nelumbo lutea* and *Typha latifolia*. Understory species are mixed, but include shrubs, such as *Cornus drummondii* and *Asimina triloba* (in Kansas), sedges and grasses, which sometimes help form savanna vegetation. Flooding is the primary dynamic process, but drought, grazing, and fire have all had historical influence on this system. Federal reservoirs have had a serious and negative effect on this system, along with agriculture that has converted much of this system to drained agricultural land.

Comments: The distribution limit northward is considered to be the Laurentian region boundary. This system is distinguished from floodplain systems northeastward, Laurentian-Acadian Floodplain Forest (CES201.587), and eastward, Central Appalachian River Floodplain (CES202.608). *Celtis* and *Populus deltoides* are absent (or essentially so) from the Laurentian-Acadian type.

DISTRIBUTION

Range: This system is found along medium and large river floodplains throughout the glaciated Midwest ranging from eastern Kansas and western Missouri to western Ohio and north along the Red River basin in Minnesota.

Divisions: 202:C, 205:C

TNC Ecoregions: 35:C, 36:C, 45:C, 46:C, 47:?, 48:?

Nations: US

Subnations: IA, IL, IN, KS, MI, MN, MO, ND, NE, OH, SD, WI

Map Zones: 38:C, 39:C, 40:C, 42:C, 43:C, 44:P, 47:C, 49:C, 50:C, 51:C, 52:C

USFS Ecomap Regions: 222H:CC, 222I:CC, 222Ja:CCC, 222Jb:CCC, 222Jc:CCC, 222Je:CCC, 222Jg:CCC, 222Jh:CCC, 222Ji:CCC, 222K:CC, 222L:CC, 222M:CC, 222Ua:CCC, 222Ud:CCC, 222Ue:CCC, 223A:CC, 251B:CC, 251E:CC, 251F:CC, 251G:CC, 251H:CC, 255A:CC, 332B:CC, 332C:CC, 332D:CC, 332E:CC

CONCEPT

Associations:

- *Carya illinoensis* - *Celtis laevigata* Forest (CEGL002087, G4?)
- *Salix interior* Temporarily Flooded Shrubland (CEGL008562, G4G5)
- *Populus deltoides* - (*Salix nigra*) / *Spartina pectinata* - *Carex* spp. Woodland (CEGL002017, G1)
- *Populus deltoides* - *Fraxinus pennsylvanica* Forest (CEGL000658, G2G3)
- *Carex pellita* - *Carex* spp. - *Schoenoplectus tabernaemontani* Fen Herbaceous Vegetation (CEGL002041, G1)
- *Brasenia schreberi* Eastern Herbaceous Vegetation (CEGL004527, G4?)
- *Potamogeton* spp. - *Ceratophyllum* spp. Midwest Herbaceous Vegetation (CEGL002282, G5)
- *Fraxinus pennsylvanica* - *Ulmus* spp. - *Celtis occidentalis* Forest (CEGL002014, G3G5)
- *Schoenoplectus fluviatilis* - *Schoenoplectus* spp. Herbaceous Vegetation (CEGL002221, G3G4)
- *Sagittaria latifolia* - *Leersia oryzoides* Herbaceous Vegetation (CEGL005240, GNR)
- *Nelumbo lutea* Herbaceous Vegetation (CEGL004323, G4?)
- *Quercus macrocarpa* - *Quercus bicolor* - *Carya laciniosa* / *Leersia* spp. - *Cinna* spp. Forest (CEGL002098, G2G3)
- River Mudflats Sparse Vegetation (CEGL002314, GNR)
- *Fraxinus pennsylvanica* - (*Ulmus americana*) / *Symphoricarpos occidentalis* Forest (CEGL002088, G4?)
- *Populus deltoides* - *Platanus occidentalis* Forest (CEGL002095, G1G2)
- *Schoenoplectus tabernaemontani* - *Typha* spp. - (*Sparganium* spp., *Juncus* spp.) Herbaceous Vegetation (CEGL002026, G4G5)

- *Calamagrostis stricta* - *Carex sartwellii* - *Carex praegracilis* - *Plantago eriopoda* Saline Herbaceous Vegetation (CEGL002255, G2G3)
- *Carex* spp. - (*Carex pellita*, *Carex vulpinoidea*) Herbaceous Vegetation (CEGL005272, GNR)
- *Fraxinus pennsylvanica* - *Celtis* spp. - *Quercus* spp. - *Platanus occidentalis* Bottomland Forest (CEGL002410, G3G4)
- *Betula nigra* - *Platanus occidentalis* Forest (CEGL002086, G5)
- *Fraxinus pennsylvanica* - *Celtis occidentalis* - *Tilia americana* - (*Quercus macrocarpa*) Forest (CEGL002081, G4?)
- *Acer saccharinum* - *Ulmus americana* Forest (CEGL002586, G4?)
- *Cephalanthus occidentalis* / *Carex* spp. Northern Shrubland (CEGL002190, G4)
- *Acer saccharinum* - *Celtis laevigata* - *Carya illinoensis* Forest (CEGL002431, G3G4)
- Riverine Sand Flats - Bars Sparse Vegetation (CEGL002049, G4G5)
- *Fraxinus pennsylvanica* - *Ulmus americana* - (*Acer negundo*, *Tilia americana*) Northern Forest (CEGL002089, G3G4)
- *Populus deltoides* - *Salix nigra* Forest (CEGL002018, G3G4)
- *Fagus grandifolia* - *Quercus* spp. - *Acer rubrum* - *Juglans nigra* Forest (CEGL005014, G2G3)
- *Carex (rostrata, utriculata)* - *Carex lacustris* - (*Carex vesicaria*) Herbaceous Vegetation (CEGL002257, G4G5)
- *Typha* spp. Midwest Herbaceous Vegetation (CEGL002233, G5)
- *Cephalanthus occidentalis* / *Carex* spp. - *Lemna* spp. Southern Shrubland (CEGL002191, G4)
- *Salix* spp. / *Andropogon gerardii* - *Sorghastrum nutans* Gravel Wash Herbaceous Vegetation (CEGL005175, G2Q)
- *Phalaris arundinacea* Eastern Herbaceous Vegetation (CEGL006044, GNA)
- *Acer saccharum* - *Carya cordiformis* / *Asimina triloba* Floodplain Forest (CEGL005035, G2)
- *Salix nigra* Forest (CEGL002103, G4)
- *Nuphar advena* - *Nymphaea odorata* Herbaceous Vegetation (CEGL002386, G4G5)

High-ranked species: *Oarisma poweshiek* (G1), *Plebejus melissa samuelis* (G5T2)

Environment: This ecological system occurs in floodplains of medium to large rivers. It primarily is found on alluvial soils ranging from sandy to very dense clays.

Vegetation: The variety of soil properties associated with this system can create a mixture of vegetation. *Acer saccharinum* occurs on the wetter soils of floodplains in the eastern portion of this system, with *Populus deltoides* and willows, especially *Salix nigra*, occurring more in the western range of this system. *Fraxinus pennsylvanica*, *Ulmus americana*, and *Quercus macrocarpa* occur in more well-drained areas. Understory species can vary across the range of this system but can include shrubs such as *Cornus drummondii* and *Asimina triloba*, and sedge and grass species. Oxbows within this system may have species such as *Nelumbo lutea* and *Typha latifolia*.

Dynamics: This system is primarily controlled by moderate to frequent flooding. Grazing can also impact this system and can lead to decreased cover of many graminoid species in some areas.

SOURCES

References: Comer et al. 2003, Eyre 1980, Rolfsmeier and Steinauer 2010

Version: 18 Jul 2006

Stakeholders: Canada, Midwest, Southeast

Concept Author: S. Menard and K. Kindscher

LeadResp: Midwest

G653. Silver Maple - Green Ash - Black Ash Floodplain Forest

CES201.587 LAURENTIAN-ACADIAN FLOODPLAIN FOREST

Primary Division: Laurentian-Acadian (201)

Land Cover Class: Mixed Upland and Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland

Diagnostic Classifiers: Forest and Woodland (Treed); Shrubland (Shrub-dominated); Woody-Herbaceous; Herbaceous; Riverine / Alluvial; Flood Scouring; Short (<5 yrs) Flooding Interval [Short interval, Spring Flooding]

Concept Summary: This system encompasses north-temperate floodplains in the northeastern and north-central U.S. and adjacent Canada at the northern end of the range of silver maple. They occur along medium to large rivers where topography and process have resulted in the development of a complex of upland and wetland temperate alluvial vegetation on generally flat topography. This complex includes floodplain forests, with *Acer saccharinum* characteristic, as well as herbaceous sloughs and shrub wetlands. In areas subject to more scour, sparse non-wetland vegetation may develop on sandbars or exposed rock. Most areas are underwater each spring; microtopography determines how long the various habitats are inundated. Associated trees include *Acer rubrum* and *Carpinus caroliniana*, the latter frequent but never abundant. On terraces or in more calcareous areas, *Acer saccharum* or *Quercus rubra* may be locally prominent, with *Betula alleghaniensis* and *Fraxinus* spp. *Salix nigra* is characteristic of the levees adjacent to the channel. Common shrubs include *Cornus amomum* and *Viburnum* spp. The herb layer in the forested portions often features abundant spring ephemerals, giving way to a fern-dominated understory in many areas by mid-summer. Non-forested wetlands associated with these systems include shrub-dominated and graminoid-herbaceous vegetation.

Comments: These floodplains are similar to those to the south in the Central Interior, North-Central Interior Floodplain (CES202.694) and Appalachian Division, Central Appalachian River Floodplain (CES202.608) in having *Acer saccharinum* as a

characteristic species; however, they are generally more depauperate and lack certain tree species that characterize central Appalachian floodplains such as *Platanus occidentalis*, *Betula nigra*, and *Quercus palustris*. This system can include areas of scour along sandbars or rivershore rock outcrops as well as the more typical floodplain vegetation.

DISTRIBUTION

Range: Central and northern New England and adjacent Canada west to the Great Lakes.

Divisions: 103:C, 201:C

TNC Ecoregions: 47:C, 48:C, 61:C, 63:C, 64:C

Nations: CA, US

Subnations: MA?, ME, MI, MN, NB, NH, NY, VT, WI

Map Zones: 41:C, 50:C, 51:C, 63:C, 64:C, 65:C, 66:C

USFS Ecomap Regions: 211A:CC, 211B:CC, 211C:CC, 211D:CC, 211E:CC, 212H:CC, 212J:CC, 212K:CC, 212L:CC, 212M:CC, 212N:CC, 212Q:CC, 212Ra:CCC, 212Rb:CCP, 212Rc:CCC, 212Rd:CCC, 212Re:CCC, 212Sb:CCP, 212Sc:CCP, 212Sn:CCC, 212Sq:CCP, 212Tb:CCP, 212Tc:CCC, 212Te:CCC, 212Xb:CCP, 212Xc:CCP, 212Xq:CCC, 212Ya:CCC, 212Z:CC, 222N:CC, 251A:CC, M211A:CC, M211B:CC, M211C:CC, M211D:CC

CONCEPT

Associations:

- *Calamagrostis canadensis* - *Scirpus* spp. - *Dulichium arundinaceum* Herbaceous Vegetation (CEGL006519, GNR)
 - *Cephalanthus occidentalis* - *Decodon verticillatus* Shrubland (CEGL006069, G4G5)
 - *Hudsonia tomentosa* - *Paronychia argyrocoma* Dwarf-shrubland (CEGL006232, G1)
 - Igneous - Metamorphic Cobble - Gravel River Shore Sparse Vegetation (CEGL002304, G4G5)
 - *Acer saccharum* - *Fraxinus* spp. - *Tilia americana* / *Matteuccia struthiopteris* - *Ageratina altissima* Forest (CEGL006114, GNR)
 - Sandstone Bedrock River Shore Sparse Vegetation (CEGL002302, GNR)
 - *Acer saccharinum* / *Onoclea sensibilis* - *Boehmeria cylindrica* Forest (CEGL006176, GNR)
 - River Mudflats Sparse Vegetation (CEGL002314, GNR)
 - *Vaccinium* spp. / *Danthonia spicata* - *Solidago puberula* Sparse Vegetation (CEGL006531, GNR)
 - *Acer rubrum* - *Prunus serotina* / *Cornus amomum* Forest (CEGL006503, GNR)
 - *Spartina pectinata* - *Muhlenbergia richardsonis* - *Sporobolus heterolepis* - *Oligoneuron album* - *Euthamia graminifolia* Sparse Vegetation (CEGL005233, G1)
 - *Acer saccharum* / *Ostrya virginiana* / *Brachyelytrum erectum* Forest (CEGL006504, GNR)
 - *Acer saccharinum* - (*Populus deltoides*) / *Matteuccia struthiopteris* - *Laportea canadensis* Forest (CEGL006147, G4G5)
 - *Acer* (*rubrum*, *saccharinum*) - *Fraxinus pennsylvanica* / *Ilex verticillata* / *Osmunda regalis* Forest (CEGL006630, GNR)
 - *Acer saccharinum* - *Ulmus americana* Forest (CEGL002586, G4?)
 - *Acer rubrum* - *Abies balsamea* / *Viburnum nudum* var. *cassinoides* Floodplain Forest (CEGL006501, GNR)
 - *Fraxinus pennsylvanica* - *Ulmus americana* - (*Acer negundo*, *Tilia americana*) Northern Forest (CEGL002089, G3G4)
 - *Alnus incana* - *Cornus* (*amomum*, *sericea*) / *Clematis virginiana* Shrubland (CEGL006062, G4G5)
 - *Prunus pumila* var. *depressa* / *Deschampsia caespitosa* Herbaceous Vegetation (CEGL006437, GNR)
 - *Andropogon gerardii* - *Campanula rotundifolia* - *Solidago simplex* Sparse Vegetation (CEGL006284, G2)
- High-ranked species:** *Clonophis kirtlandii* (G2), *Grus americana* (G1), *Mimulus glabratus* var. *michiganensis* (G5T1), *Myotis sodalis* (G2), *Ophiogomphus smithi* (G2G3), *Papaipema* sp. 2 nr. *ptersii* (G3G4), *Somatochlora hineana* (G2G3)

SOURCES

References: Comer et al. 2003, Eyre 1980, Gawler and Cutko 2010

Version: 05 Jun 2008

Concept Author: S.C. Gawler

Stakeholders: Canada, East, Midwest, Southeast

LeadResp: East

G673. Silver Maple - Sugarberry - Sweetgum Floodplain Forest

CES202.608 CENTRAL APPALACHIAN RIVER FLOODPLAIN

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Mixed Upland and Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland

Diagnostic Classifiers: Forest and Woodland (Treed); Toeslope/Valley Bottom; Riverine / Alluvial; Broad-Leaved Deciduous Tree; Intermittent Flooding; Short (<5 yrs) Flooding Interval

Concept Summary: This system encompasses floodplains of medium to large rivers in Atlantic drainages from southern New England to Virginia. This system can include a complex of wetland and upland vegetation on deep alluvial deposits and scoured vegetation on depositional bars and on bedrock where rivers cut through resistant geology. This complex includes floodplain forests in which *Acer saccharinum*, *Populus deltoides*, and *Platanus occidentalis* are characteristic, as well as herbaceous sloughs, shrub

wetlands, riverside prairies and woodlands. Most areas are underwater each spring; microtopography determines how long the various habitats are inundated. Depositional and erosional features may both be present depending on the particular floodplain.

Comments: This system is distinguished from related floodplain systems; northward, Laurentian-Acadian Floodplain Forest (CES201.587) is characterized by the lack or unimportance of *Platanus occidentalis* and *Betula nigra*, for example; and westward, North-Central Interior Floodplain (CES202.694) drains to the midwestern rivers rather than northeastern rivers. Determining the distinctions from South-Central Interior Large Floodplain (CES202.705), which overlaps the southern and western portions of this system, needs work.

DISTRIBUTION

Range: Southern New England west to Lake Erie and south to Virginia. The James River in Virginia marks the southern extent of this system.

Divisions: 201:C, 202:C

TNC Ecoregions: 49:C, 52:C, 59:C, 60:C, 61:C

Nations: US

Subnations: CT, MA, MD, NH, NJ?, NY, OH, PA, VA, VT, WV

Map Zones: 53:C, 59:C, 60:C, 61:C, 62:C, 63:C, 64:C, 65:C

CONCEPT

Associations:

- *Betula nigra* - *Platanus occidentalis* / *Impatiens capensis* Forest (CEGL006184, G3Q)
- *Justicia americana* Herbaceous Vegetation (CEGL004286, G4G5)
- *Cephalanthus occidentalis* - *Decodon verticillatus* Shrubland (CEGL006069, G4G5)
- *Acer saccharum* - *Fraxinus* spp. - *Tilia americana* / *Matteuccia struthiopteris* - *Ageratina altissima* Forest (CEGL006114, GNR)
- *Platanus occidentalis* - *Fraxinus pennsylvanica* Forest (CEGL006036, G4?)
- *Acer (rubrum, saccharinum)* - *Fraxinus pennsylvanica* - *Ulmus americana* / *Boehmeria cylindrica* Forest (CEGL006548, G4)
- *Acer saccharinum* / *Onoclea sensibilis* - *Boehmeria cylindrica* Forest (CEGL006176, GNR)
- *Fraxinus pennsylvanica* - *Ulmus* spp. - *Celtis occidentalis* Forest (CEGL002014, G3G5)
- *Acer negundo* Forest (CEGL005033, G4G5)
- *Eragrostis hypnoides* - *Ludwigia palustris* - *Lindernia dubia* - *Cyperus squarrosus* Herbaceous Vegetation (CEGL006483, G3)
- *Acer saccharinum* - *Ulmus americana* / *Onoclea sensibilis* Forest (CEGL006001, GNR)
- *Carex torta* - *Apocynum cannabinum* - *Cyperus* spp. Herbaceous Vegetation (CEGL006536, G4G5)
- *Peltandra virginica* - *Saururus cernuus* - *Boehmeria cylindrica* / *Climacium americanum* Herbaceous Vegetation (CEGL007696, G3)
- *Pinus virginiana* - *Juniperus virginiana* var. *virginiana* - *Quercus stellata* / *Amelanchier stolonifera* / *Danthonia spicata* / *Leucobryum glaucum* Woodland (CEGL008449, G1)
- *Betula nigra* - *Platanus occidentalis* Forest (CEGL002086, G5)
- *Acer saccharinum* - (*Populus deltoides*) / *Matteuccia struthiopteris* - *Laportea canadensis* Forest (CEGL006147, G4G5)
- *Acer saccharinum* - *Ulmus americana* / *Physocarpus opulifolius* Forest (CEGL006042, GNR)
- *Prunus pumila* / *Andropogon gerardii* - *Sorghastrum nutans* Herbaceous Vegetation (CEGL006518, G3)
- *Salix sericea* Shrubland (CEGL006305, GNR)
- *Acer saccharinum* - *Acer negundo* / *Ageratina altissima* - *Laportea canadensis* - (*Elymus virginicus*) Forest (CEGL006217, G4)
- *Platanus occidentalis* - *Acer negundo* - *Juglans nigra* / *Asimina triloba* / *Mertensia virginica* Forest (CEGL004073, G4)
- *Alnus serrulata* Swamp Shrubland (CEGL005082, G4G5)
- *Liriodendron tulipifera* - *Fraxinus* spp. / *Lindera benzoin* - *Viburnum prunifolium* / *Podophyllum peltatum* Forest (CEGL006314, GNR)
- *Platanus occidentalis* / *Aesculus flava* Forest (CEGL006466, GNR)
- *Acer saccharum* - *Fraxinus americana* / *Carpinus caroliniana* / *Podophyllum peltatum* Forest (CEGL006459, G3?)
- *Carya cordiformis* - *Prunus serotina* / *Ageratina altissima* Forest (CEGL006445, G2G3)
- *Carex trichocarpa* Herbaceous Vegetation (CEGL006447, G4?)
- *Quercus bicolor* - *Fraxinus pennsylvanica* - (*Platanus occidentalis*) / *Chasmanthium latifolium* - *Dichanthelium clandestinum* - *Zizia aurea* Woodland (CEGL006218, G1G2)
- *Spiraea alba* Shrubland (CEGL006595, GNR)
- *Acer saccharum* - *Liriodendron tulipifera* / *Galium concinnum* - *Carex laxiculmis* Forest (CEGL006473, GNR)
- (*Hypericum prolificum*, *Leucothoe racemosa*) / *Schizachyrium scoparium* - *Solidago simplex* var. *racemosa* - *Ionactis linariifolius* Sparse Vegetation (CEGL006491, G2)
- *Quercus palustris* - *Quercus bicolor* / *Carex tribuloides* - *Carex radiata* - (*Carex squarrosa*) Forest (CEGL006497, G3G4)
- *Juglans nigra* / *Verbesina alternifolia* Semi-natural Forest (CEGL007879, GNA)
- *Andropogon gerardii* - *Panicum virgatum* - *Baptisia australis* Herbaceous Vegetation (CEGL006283, G3)
- *Acer saccharinum* - *Ulmus americana* Forest (CEGL002586, G4?)
- *Calamagrostis canadensis* - *Eupatorium maculatum* Herbaceous Vegetation (CEGL005174, G4G5)
- *Quercus bicolor* - *Acer rubrum* / *Carpinus caroliniana* Forest (CEGL006386, GNR)

- *Quercus palustris* - *Acer rubrum* / *Carex grayi* - *Geum canadense* Forest (CEGL006185, G3)
- *Liriodendron tulipifera* - *Pinus strobus* - (*Tsuga canadensis*) / *Carpinus caroliniana* / *Amphicarpaea bracteata* Forest (CEGL008405, G3)
- *Fagus grandifolia* - *Quercus* spp. - *Acer rubrum* - *Juglans nigra* Forest (CEGL005014, G2G3)
- *Carex torta* Herbaceous Vegetation (CEGL004103, G3G4)
- *Acer* (*rubrum*, *saccharinum*) - *Ulmus americana* Forest (CEGL006975, GNR)
- *Tilia americana* - *Acer saccharum* - *Acer nigrum* / *Laportea canadensis* Forest (CEGL006405, GNR)
- *Cephalanthus occidentalis* / *Carex* spp. - *Lemna* spp. Southern Shrubland (CEGL002191, G4)
- *Alnus serrulata* - *Physocarpus opulifolius* Shrubland (CEGL006251, G5)
- *Salix nigra* - *Betula nigra* / *Schoenoplectus pungens* Wooded Herbaceous Vegetation (CEGL006463, G1?)
- *Fraxinus pennsylvanica* - (*Juglans nigra*, *Platanus occidentalis*) Forest (CEGL006575, GNR)
- *Alnus incana* - *Viburnum recognitum* / *Calamagrostis canadensis* Shrubland (CEGL006546, GNR)
- *Liriodendron tulipifera* - *Platanus occidentalis* - *Betula lenta* / *Lindera benzoin* / *Circaea lutetiana* ssp. *canadensis* Forest (CEGL006255, G3?)
- *Peltandra virginica* - *Polygonum amphibium* var. *emersum* - *Carex emoryi* - *Impatiens capensis* Herbaceous Vegetation (CEGL006244, G1)
- *Verbesina alternifolia* - *Elymus riparius* - *Solidago gigantea* - (*Teucrium canadense*) Herbaceous Vegetation (CEGL006480, GNR)
- *Platanus occidentalis* - *Betula nigra* - *Salix* (*caroliniana*, *nigra*) Woodland (CEGL003896, G4G5)
- *Platanus occidentalis* - *Acer saccharinum* - *Betula nigra* - *Fraxinus pennsylvanica* / *Boehmeria cylindrica* - *Carex emoryi* Woodland (CEGL006476, G2?)
- *Fraxinus americana* / *Andropogon gerardii* - *Sorghastrum nutans* - *Schizachyrium scoparium* - *Pycnanthemum tenuifolium* Herbaceous Vegetation (CEGL006478, G1)
- *Eupatorium serotinum* - *Polygonum* (*lapathifolium*, *punctatum*, *pensylvanicum*) Herbaceous Vegetation (CEGL006481, GNR)
- *Carpinus caroliniana* - *Ilex decidua* Shrubland (CEGL006484, G1?)
- *Quercus rubra* - *Quercus shumardii* / *Cercis canadensis* Temporarily Flooded Forest (CEGL006495, GNR)

High-ranked species: *Arabis georgiana* (G1), *Aspiromitus appalachianus* (G1), *Canis rufus* (G1Q), *Catocala marmorata* (G3G4), *Cicindela ancocisconensis* (G3), *Diervilla rivularis* (G3), *Eurycea junaluska* (G3), *Fissidens appalachensis* (G2G3), *Glyptemys insculpta* (G3), *Gymnoderma lineare* (G3), *Hygrohypnum closteri* (G3), *Lejeunea blomquistii* (G1G2), *Lysimachia fraseri* (G3), *Marshallia grandiflora* (G2), *Myotis austroriparius* (G3G4), *Plethodon aureolus* (G2G3), *Puma concolor cougar* (G5THQ), *Sagittaria secundifolia* (G1), *Sorex palustris punctulatus* (G5T3), *Spiraea virginiana* (G2)

SOURCES

References: Comer et al. 2003, Eyre 1980

Version: 01 Feb 2007

Concept Author: S.C. Gawler, mod. NCR Review Team

Stakeholders: East, Midwest, Southeast

LeadResp: East

CES202.705 SOUTH-CENTRAL INTERIOR LARGE FLOODPLAIN

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Mixed Upland and Wetland

Spatial Scale & Pattern: Linear

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland

Concept Summary: This floodplain system is found in the Interior Highlands as far west as eastern Oklahoma, as well as throughout the Interior Low Plateau, Cumberlands, Southern Ridge and Valley, and Western Allegheny Plateau, and lower elevations of the Southern Blue Ridge. Examples occur along large rivers or streams where topography and alluvial processes have resulted in a well-developed floodplain. A single occurrence may extend from river's edge across the outermost extent of the floodplain or to where it meets a wet meadow or upland system. Many examples of this system will contain well-drained levees, terraces and stabilized bars, and some will include herbaceous sloughs and shrub wetlands resulting, in part, from beaver activity. A variety of soil types may be found within the floodplain from very well-drained sandy substrates to very dense clays. It is this variety of substrates in combination with different flooding regimes that creates the mix of vegetation. Most areas, except for the montane alluvial forests, are inundated at some point each spring; microtopography determines how long the various habitats are inundated. Although vegetation is quite variable in this broadly defined system, examples may include *Acer saccharinum*, *Platanus occidentalis*, *Liquidambar styraciflua*, and *Quercus* spp. Understory species are mixed, but include shrubs, such as *Cephalanthus occidentalis* and *Arundinaria gigantea* ssp. *gigantea*, and sedges (*Carex* spp.). This system likely floods at least once annually and can be altered by occasional severe floods. Impoundments and conversion to agriculture can also impact this system.

Comments: Montane alluvial forests may be difficult to place within this system because they share traits with both this system and Southern and Central Appalachian Cove Forest (CES202.373), at least in the southern Appalachians. This split from Central Appalachian River Floodplain (CES202.608) may appear somewhat arbitrary but is based on the freshwater systems classification, using roughly the Mid-Continental Divide. This means that Ecoregions 50 and 51 are included in this system, whereas Ecoregions 52 and 59 are considered part of Central Appalachian River Floodplain (CES202.608) (except for a small part of southernmost Ecoregion 59 in West Virginia that drains to the Ohio River). This system grades into Western Great Plains Floodplain (CES303.678) in the

Crosstimbers region of east-central Oklahoma as eastern cottonwood (*Populus deltoides*) and willows (*Salix* spp.) become more dominant.

DISTRIBUTION

Range: This system ranges from the Ozarks, Arkansas River Valley, and Interior Low Plateau to the Southern Blue Ridge and north into the Western Allegheny Plateau.

Divisions: 202:C, 205:C

TNC Ecoregions: 32:P, 37:C, 38:C, 39:C, 44:C, 49:C, 50:C, 51:C, 59:C

Nations: US

Subnations: AL, AR, GA, IL, IN, KY, MO, NC, OH, OK, PA, SC?, TN, VA, WV

Map Zones: 32:P, 37:P, 38:?, 43:C, 44:C, 47:C, 48:C, 49:C, 53:C, 57:C, 61:C, 62:C

CONCEPT

Associations:

- *Justicia americana* Herbaceous Vegetation (CEGL004286, G4G5)
- *Hypericum densiflorum* - *Alnus serrulata* / *Tripsacum dactyloides* Shrubland (CEGL008495, G1G2)
- *Platanus occidentalis* - *Fraxinus pennsylvanica* - *Quercus imbricaria* Forest (CEGL007339, G2Q)
- *Fraxinus pennsylvanica* - *Ulmus crassifolia* - *Celtis laevigata* Forest (CEGL004618, GNR)
- *Salix nigra* Large River Floodplain Forest (CEGL007410, G3G5)
- *Quercus palustris* - (*Fraxinus nigra*) / *Lindera benzoin* / *Carex bromoides* Forest (CEGL007399, GNR)
- *Quercus palustris* - (*Quercus stellata*) - *Quercus pagoda* / *Isoetes* spp. Forest (CEGL002101, G2G3)
- *Platanus occidentalis* - *Liriodendron tulipifera* - *Betula (alleghaniensis, lenta)* / *Alnus serrulata* - *Leucothoe fontanesiana* Forest (CEGL004691, G2?)
- *Quercus phellos* - (*Quercus lyrata*) / *Carex* spp. - *Leersia* spp. Forest (CEGL002102, G3G4Q)
- *Acer negundo* Forest (CEGL005033, G4G5)
- *Platanus occidentalis* - *Fraxinus pennsylvanica* / *Carpinus caroliniana* / *Verbesina alternifolia* Forest (CEGL006458, G3Q)
- *Acer saccharinum* - *Betula nigra* / *Cephalanthus occidentalis* Forest (CEGL007810, G3Q)
- *Platanus occidentalis* - *Betula nigra* - *Celtis laevigata* - *Fraxinus pennsylvanica* / *Arundinaria gigantea* Temporarily Flooded Forest (CEGL007999, G3?)
- *Osmunda regalis* var. *spectabilis* Seepage Scour Herbaceous Vegetation (CEGL008404, G3?)
- *Quercus stellata* - *Quercus marilandica* - *Quercus falcata* / *Schizachyrium scoparium* Sand Woodland (CEGL002417, G2)
- *Liquidambar styraciflua* - *Liriodendron tulipifera* - (*Platanus occidentalis*) / *Carpinus caroliniana* - *Halesia tetraptera* / *Amphicarpaea bracteata* Forest (CEGL007880, G3G4)
- *Taxodium distichum* / *Lemna minor* Forest (CEGL002420, G4G5)
- *Quercus nigra* - *Quercus (alba, phellos)* Forest (CEGL004979, G3?)
- *Betula nigra* - *Platanus occidentalis* Forest (CEGL002086, G5)
- *Platanus occidentalis* - *Betula nigra* / *Cornus amomum* / (*Andropogon gerardii*, *Chasmanthium latifolium*) Woodland (CEGL003725, G3)
- *Fraxinus pennsylvanica* - *Ulmus americana* - *Celtis laevigata* / *Ilex decidua* Forest (CEGL002427, G4G5)
- *Platanus occidentalis* - *Acer saccharinum* - *Juglans nigra* - *Ulmus rubra* Forest (CEGL007334, G4)
- *Platanus occidentalis* / *Aesculus flava* Forest (CEGL006466, GNR)
- *Quercus (rubra, velutina, alba)* / *Carpinus caroliniana* - (*Halesia tetraptera*) / *Maianthemum racemosum* Forest (CEGL006462, G1)
- *Juglans nigra* / *Verbesina alternifolia* Semi-natural Forest (CEGL007879, GNA)
- *Acer saccharinum* - *Ulmus americana* Forest (CEGL002586, G4?)
- *Acer saccharinum* - *Celtis laevigata* - *Carya illinoensis* Forest (CEGL002431, G3G4)
- (*Diospyros virginiana*, *Platanus occidentalis*) / *Eupatorium serotinum* - *Diodia virginiana* Herbaceous Vegetation (CEGL003910, GNA)
- *Arundinaria gigantea* ssp. *gigantea* Shrubland (CEGL003836, G2?)
- *Populus deltoides* - *Salix nigra* Forest (CEGL002018, G3G4)
- *Liquidambar styraciflua* - *Quercus michauxii* - *Carya laciniosa* / *Fagus grandifolia* - (*Aesculus flava*) Forest (CEGL007702, G2G3Q)
- *Fagus grandifolia* - *Quercus* spp. - *Acer rubrum* - *Juglans nigra* Forest (CEGL005014, G2G3)
- *Carex torta* Herbaceous Vegetation (CEGL004103, G3G4)
- *Cephalanthus occidentalis* / *Carex* spp. - *Lemna* spp. Southern Shrubland (CEGL002191, G4)
- *Acer rubrum* var. *trilobum* - *Fraxinus pennsylvanica* / *Carex crinita* - *Peltandra virginica* Forest (CEGL004420, G1)
- *Quercus stellata* / (*Danthonia spicata*, *Croton willdenowii*) Woodland (CEGL005057, G1)
- *Alnus serrulata* - *Xanthorhiza simplicissima* Shrubland (CEGL003895, G3G4)
- *Acer saccharum* - *Carya cordiformis* / *Asimina triloba* Floodplain Forest (CEGL005035, G2)
- River Valley Impoundment Mudflat Sparse Vegetation (CEGL004049, GNA)
- *Quercus michauxii* - *Quercus shumardii* - *Liquidambar styraciflua* / *Arundinaria gigantea* Forest (CEGL002099, G3G4)

- *Salix nigra* Forest (CEGL002103, G4)
- *Nuphar advena* - *Nymphaea odorata* Herbaceous Vegetation (CEGL002386, G4G5)
- *Verbesina alternifolia* - *Elymus riparius* - *Solidago gigantea* - (*Teucrium canadense*) Herbaceous Vegetation (CEGL006480, GNR)
- *Tsuga canadensis* - *Quercus rubra* - (*Platanus occidentalis*, *Betula nigra*) / *Rhododendron maximum* / *Anemone quinquefolia* Forest (CEGL006620, GNR)
- *Quercus macrocarpa* - *Quercus shumardii* - *Carya cordiformis* / *Chasmanthium latifolium* Forest (CEGL004544, G3?)
- *Salix caroliniana* Temporarily Flooded Ozark Shrubland (CEGL007064, G4?)
- *Schoenoplectus tabernaemontani* - *Typha* spp. - (*Sparganium* spp., *Juncus* spp.) Herbaceous Vegetation (CEGL002026, G4G5)
- *Carya illinoensis* - *Celtis laevigata* Forest (CEGL002087, G4?)
- River Mudflats Sparse Vegetation (CEGL002314, GNR)
- *Fraxinus pennsylvanica* - *Celtis* spp. - *Quercus* spp. - *Platanus occidentalis* Bottomland Forest (CEGL002410, G3G4)
- *Polygonum* spp. - Mixed Forbs Herbaceous Vegetation (CEGL002430, G4G5)
- *Lemna* spp. Permanently Flooded Herbaceous Vegetation (CEGL003059, G5)
- *Salix interior* Temporarily Flooded Shrubland (CEGL008562, G4G5)

High-ranked species: *Arabis georgiana* (G1), *Aspiromitus appalachianus* (G1), *Betula uber* (G1Q), *Canis rufus* (G1Q), *Catalpa bignonioides* (G3G4), *Catocala marmorata* (G3G4), *Cicindela ancociscenensis* (G3), *Desmognathus imitator* (G3G4), *Diervilla rivularis* (G3), *Eurycea junaluska* (G3), *Fissidens appalachensis* (G2G3), *Glyptemys insculpta* (G3), *Gymnoderma lineare* (G3), *Hygrohypnum closteri* (G3), *Lejeunea blomquistii* (G1G2), *Lethe creola* (G3G4), *Lysimachia fraseri* (G3), *Marshallia grandiflora* (G2), *Myotis austroriparius* (G3G4), *Nardia lescurei* (G3?), *Nesticus* sp. 2 (G1G3), *Plethodon aureolus* (G2G3), *Plethodon hubrichti* (G2), *Plethodon punctatus* (G3), *Potamogeton tennesseensis* (G2G3), *Puma concolor cougar* (G5THQ), *Sagittaria secundifolia* (G1), *Sorex palustris punctulatus* (G5T3), *Speyeria diana* (G3G4), *Spiraea virginiana* (G2), *Thermopsis villosa* (G3?), *Trillium pusillum* (G3), *Vitis rupestris* (G3)

Environment: This system inhabits broad floodplains along large creeks and rivers that are usually inundated for at least part of each year.

Vegetation: Vegetation varies quite widely, encompassing shrubby and herbaceous communities, as well as forested communities with a wide array of canopy types. Examples may include *Acer saccharinum*, *Platanus occidentalis*, *Liquidambar styraciflua*, and *Quercus* spp. Understory species are mixed but include shrubs, such as *Cephalanthus occidentalis* and *Arundinaria gigantea* ssp. *gigantea*, and sedges (*Carex* spp.).

Dynamics: Flooding dynamics are an important factor in the development and maintenance of this system.

SOURCES

References: Comer et al. 2003, Evans 1991, Eyre 1980, Woods et al. 2002

Version: 17 Jan 2006

Stakeholders: East, Midwest, Southeast

Concept Author: S. Menard, M. Pyne, R. Evans, R. White

LeadResp: Midwest

CES202.706 SOUTH-CENTRAL INTERIOR SMALL STREAM AND RIPARIAN

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Mixed Upland and Wetland

Spatial Scale & Pattern: Linear

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland

Concept Summary: This system is found throughout the Interior Low Plateau, Southern Ridge and Valley, Western Allegheny Plateau, lower elevations of the Southern Blue Ridge, and parts of the Cumberlands. Examples occur along small streams and floodplains with low to moderately high gradients. There may be little to moderate floodplain development. Flooding and scouring both influence this system, and the nature of the landscape prevents the kind of floodplain development found on larger rivers. This system may contain cobble bars with adjacent wooded vegetation and rarely have any marsh development, except through occasional beaver impoundments. The vegetation is a mosaic of forests, woodlands, shrublands, and herbaceous communities. Canopy cover can vary within examples of this system, but typical tree species may include *Platanus occidentalis*, *Acer rubrum* var. *trilobum*, *Betula nigra*, *Liquidambar styraciflua*, and *Quercus* spp. Shrubs and herbaceous layers can vary in richness and cover. Some characteristic shrubs may include *Hypericum densiflorum*, *Salix* spp., and *Alnus* spp. Small seeps dominated by sedges (*Carex* spp.), ferns (*Osmunda* spp.), and other herbaceous species can often be found within this system, especially at the headwaters and terraces of streams.

Comments: This system is closely related to Central Appalachian Stream and Riparian (CES202.609) but has been distinguished based on the precepts of the Freshwater Systems classification. This system has been divided from Central Appalachian Riparian roughly by the Mid-Continental Divide. This means that Ecoregions 50 and 51 are included in this system, whereas Ecoregions 52 and 59 are considered part of Central Appalachian Riparian (except for a small part of southernmost Ecoregion 59 in West Virginia that drains to the Ohio River). In contrast to floodplain systems, this system has little to no floodplain development. In comparison with South-Central Interior Large Floodplain (CES202.705), this system typically has somewhat higher gradients, is sometimes rocky, and may experience flash floods. Stands from somewhat larger rivers have been placed here if the river lacks substantial floodplain development (e.g., the New River of West Virginia and the Ocoee Gorge of Tennessee).

DISTRIBUTION

Range: This system ranges from the Interior Low Plateau to the Southern Blue Ridge and north into the Western Allegheny Plateau and portions of the Cumberlands. There would be limited and peripheral presence in the Upper East Gulf Coastal Plain. It also is present on Crowley's Ridge, an anomalous and distinct upland topographic feature that is embedded within the Mississippi River Alluvial Plain.

Divisions: 202:C, 203:C

TNC Ecoregions: 42:C, 43:C, 44:C, 49:C, 50:C, 51:C, 59:C

Nations: US

Subnations: AL, AR, GA, IL, IN, KY, NC, OH, PA, SC, TN, VA, WV

Map Zones: 45:C, 46:P, 47:C, 48:C, 49:C, 53:C, 57:C, 61:C, 62:C

USFS Ecomap Regions: 234D:CC

CONCEPT**Associations:**

- *Carex crinita* - *Osmunda* spp. / *Physocarpus opulifolius* Seep Herbaceous Vegetation (CEGL002392, G2)
- *Alnus serrulata* Interior Shrubland (CEGL003894, G4?)
- *Justicia americana* Herbaceous Vegetation (CEGL004286, G4G5)
- *Podostemum ceratophyllum* Herbaceous Vegetation (CEGL004331, G3G5)
- *Hymenocallis coronaria* - *Justicia americana* Herbaceous Vegetation (CEGL004285, G1)
- *Vitis rotundifolia* - *Ampelopsis arborea* - *Campsis radicans* Vine-Shrubland (CEGL004620, GNA)
- *Tsuga canadensis* - *Liriodendron tulipifera* - *Platanus occidentalis* / *Rhododendron maximum* - *Xanthorhiza simplicissima* Temporarily Flooded Forest (CEGL007143, G3)
- *Quercus (alba, coccinea, falcata, velutina)* / *Kalmia latifolia* Temporarily Flooded Forest (CEGL004098, G4?)
- *Betula nigra* - *Platanus occidentalis* / *Alnus serrulata* / *Boehmeria cylindrica* Forest (CEGL007312, G4G5)
- *Quercus alba* - (*Liriodendron tulipifera*, *Liquidambar styraciflua*) / *Calycanthus floridus* / *Athyrium filix-femina* Forest (CEGL008428, G3G4)
- *Orontium aquaticum* Permanently Flooded Herbaceous Vegetation (CEGL008480, G3G4)
- *Eragrostis hypnoides* - *Ludwigia palustris* - *Lindernia dubia* - *Cyperus squarrosus* Herbaceous Vegetation (CEGL006483, G3)
- *Platanus occidentalis* - *Celtis laevigata* - *Liriodendron tulipifera* / *Lindera benzoin* - *Arundinaria gigantea* / *Amphicarpaea bracteata* Forest (CEGL008429, G4?)
- *Osmunda regalis* var. *spectabilis* Seepage Scour Herbaceous Vegetation (CEGL008404, G3?)
- *Alnus serrulata* Southeastern Seasonally Flooded Shrubland (CEGL008474, G4)
- *Liquidambar styraciflua* - *Liriodendron tulipifera* - (*Platanus occidentalis*) / *Carpinus caroliniana* - *Halesia tetraptera* / *Amphicarpaea bracteata* Forest (CEGL007880, G3G4)
- *Acer rubrum* var. *trilobum* - *Nyssa sylvatica* / *Rhododendron canescens* - *Viburnum nudum* var. *nudum* / *Woodwardia areolata* Forest (CEGL004425, G2G3)
- *Pinus virginiana* - *Juniperus virginiana* var. *virginiana* - *Quercus stellata* / *Amelanchier stolonifera* / *Danthonia spicata* / *Leucobryum glaucum* Woodland (CEGL008449, G1)
- *Juncus effusus* - *Chelone glabra* - *Scirpus* spp. Southern Blue Ridge Beaver Pond Herbaceous Vegetation (CEGL008433, G4?)
- *Betula nigra* - *Platanus occidentalis* Forest (CEGL002086, G5)
- *Carex crinita* - *Osmunda* spp. / *Sphagnum* spp. Herbaceous Vegetation (CEGL002263, G2G3)
- *Salix caroliniana* Temporarily Flooded Forest (CEGL007373, G4)
- *Platanus occidentalis* - *Betula nigra* - *Salix (caroliniana, nigra)* Woodland (CEGL003896, G4G5)
- (*Salix* spp.) / *Andropogon gerardii* - *Panicum virgatum* - *Salvia azurea* Cahaba Riverwash Herbaceous Vegetation (CEGL004149, G1)
- *Andropogon gerardii* - *Panicum virgatum* - *Baptisia australis* Herbaceous Vegetation (CEGL006283, G3)
- *Pinus taeda* - *Liriodendron tulipifera* / *Lindera benzoin* / *Carex crinita* Forest (CEGL007546, GNA)
- *Acer negundo* - (*Platanus occidentalis*, *Populus deltoides*) Forest (CEGL004690, G4)
- *Schizachyrium scoparium* - *Schoenoplectus americanus* - *Juncus marginatus* - *Eupatorium serotinum* Herbaceous Vegetation (CEGL008496, G2)
- *Polygonum (hydropiperoides, punctatum)* - *Leersia* spp. Herbaceous Vegetation (CEGL004290, G4?)
- *Sparganium americanum* - (*Sparganium erectum* ssp. *stoloniferum*) - *Epilobium leptophyllum* Herbaceous Vegetation (CEGL004510, G3?)
- *Acer rubrum* var. *trilobum* - *Nyssa sylvatica* / *Osmunda cinnamomea* - *Chasmanthium laxum* - *Carex intumescens* / *Sphagnum lescurei* Forest (CEGL007443, G3?)
- *Arundinaria gigantea* ssp. *gigantea* Shrubland (CEGL003836, G2?)
- *Salix nigra* - *Platanus occidentalis* Forest (CEGL004626, G5)
- *Fagus grandifolia* - *Quercus alba* / *Kalmia latifolia* - *Rhododendron canescens* - *Symplocos tinctoria* Forest (CEGL008551, G3?)
- *Liquidambar styraciflua* - (*Liriodendron tulipifera*) Temporarily Flooded Forest (CEGL007330, GNA)
- *Juncus effusus* Seasonally Flooded Herbaceous Vegetation (CEGL004112, G5)

- *Nuphar advena* - *Nymphaea odorata* Herbaceous Vegetation (CEGL002386, G4G5)
- *Verbesina alternifolia* - *Elymus riparius* - *Solidago gigantea* - (*Teucrium canadense*) Herbaceous Vegetation (CEGL006480, GNR)
- *Platanus occidentalis* - *Betula nigra* / *Cornus amomum* / (*Andropogon gerardii*, *Chasmanthium latifolium*) Woodland (CEGL003725, G3)
- *Alnus serrulata* - *Xanthorhiza simplicissima* Shrubland (CEGL003895, G3G4)
- *Platanus occidentalis* / *Dichanthelium clandestinum* - *Festuca subverticillata* Woodland (CEGL004031, G4)
- *Carex torta* Herbaceous Vegetation (CEGL004103, G3G4)
- *Platanus occidentalis* - *Liriodendron tulipifera* - *Betula (alleghaniensis, lenta)* / *Alnus serrulata* - *Leucothoe fontanesiana* Forest (CEGL004691, G2?)
- *Potamogeton* spp. - *Ceratophyllum* spp. - *Elodea* spp. Permanently Flooded Herbaceous Vegetation (CEGL004725, G4?)
- *Fagus grandifolia* - *Quercus* spp. - *Acer rubrum* - *Juglans nigra* Forest (CEGL005014, G2G3)
- *Salix nigra* - *Betula nigra* / *Schoenoplectus pungens* Wooded Herbaceous Vegetation (CEGL006463, G1?)
- *Platanus occidentalis* - *Liquidambar styraciflua* / *Carpinus caroliniana* - *Asimina triloba* Forest (CEGL007340, G5)
- *Peltandra virginica* - *Saururus cernuus* - *Boehmeria cylindrica* / *Climacium americanum* Herbaceous Vegetation (CEGL007696, G3)
- *Quercus alba* - *Carya (alba, ovata)* - *Liriodendron tulipifera* - (*Quercus phellos*) / *Cornus florida* Forest (CEGL007709, G4)
- *Schizachyrium scoparium* - *Andropogon ternarius* - *Liatris microcephala* - (*Pityopsis ruthii*) Herbaceous Vegetation (CEGL008455, G2)
- *Alnus serrulata* Seasonally Flooded Shrubland (CEGL008467, GNR)
- *Alnus maritima* ssp. *georgiensis* - (*Decodon verticillatus*) / *Hibiscus moscheutos* - *Sparganium americanum* Spring-run Marsh Shrubland (CEGL004145, G1)
- *Alnus serrulata* Saturated Southern Interior Shrubland (CEGL007059, G3)

High-ranked species: *Bryoerythrophyllum ferruginascens* (G3G4), *Canis rufus* (G1Q), *Cardamine longii* (G3?), *Catalpa bignonioides* (G3G4), *Catocala marmorata* (G3G4), *Cicindela ancocisconensis* (G3), *Desmognathus aeneus* (G3G4), *Desmognathus wrighti* (G3), *Fissidens appalachensis* (G2G3), *Glyptemys insculpta* (G3), *Gymnoderma lineare* (G3), *Hexastylis naniflora* (G3), *Hexastylis rhombiformis* (G3), *Hexastylis shuttleworthii* var. *harperi* (G4T3), *Isotria medeoloides* (G2), *Jamesianthus alabamensis* (G3), *Lejeunea blomquistii* (G1G2), *Lysimachia fraseri* (G3), *Marshallia grandiflora* (G2), *Marshallia trinervia* (G3), *Megaceros aenigmaticus* (G3), *Melanoplus serrulatus* (G1G3), *Myotis austroriparius* (G3G4), *Pityopsis ruthii* (G1), *Plethodon hubrichti* (G2), *Plethodon punctatus* (G3), *Sagittaria secundifolia* (G1), *Speyeria diana* (G3G4), *Spiraea virginiana* (G2), *Trillium pusillum* (G3), *Trillium rugelii* (G3), *Vitis rupestris* (G3), *Waldsteinia lobata* (G2G3)

Environment: This system is found along fairly high-energy streams and rivers with steep banks, this system is subject to frequent flooding and can be subject to scouring depending upon the substrate. Some associations do not flood but instead are saturated zones or patches near the streams.

Vegetation: There is wide variation in vegetation depending upon the frequency of the flooding cycle (more frequent flooding creates a better environment for forbs and shrubs, less frequent may create a better environment for the establishment of trees). Typical tree species may include *Platanus occidentalis*, *Acer rubrum* var. *trilobum*, *Betula nigra*, *Liquidambar styraciflua*, and *Quercus* spp. Shrubs and herbaceous layers can vary in richness and cover. Some characteristic shrubs may include *Hypericum densiflorum*, *Salix* spp., and *Alnus* spp. Small seeps dominated by sedges (*Carex* spp.), ferns (*Osmunda* spp.), and other herbaceous species can often be found within this system, especially at the headwaters and terraces of streams. These areas are not typically flooded or scoured but saturated.

Dynamics: Flooding and seed propagule dispersal caused by flooding events are the two most important processes affecting this system. The two processes vary widely depending upon size of stream, upstream land use and topography, presence or absence of invasive exotics that may displace native community types, etc.

SOURCES

References: Comer et al. 2003, Evans 1991, Eyre 1980

Version: 31 May 2012

Concept Author: S. Menard, M. Pyne, R. Evans, R. White, D.

Stakeholders: East, Midwest, Southeast

LeadResp: Midwest Faber-Langendoen

M503. CENTRAL & APPALACHIAN SWAMP FOREST

G044. Central & Appalachian Seepage Swamp

CES202.321 INTERIOR HIGHLANDS FORESTED ACIDIC SEEP

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland

Diagnostic Classifiers: Forest and Woodland (Treed); Seepage-Fed Sloping; Ozark/Ouachita

Concept Summary: This system of forested seeps occurs mainly in the Ouachita Mountains of central Arkansas, as well as on Mount Magazine and in the Ozarks. Examples may be found along the bottom slopes of smaller valleys where rock fractures allow water to seep out of the mountainsides and in the riparian zones of larger creeks, sometimes extending upslope along small ephemeral drainages. The soil remains saturated to very moist throughout the year. The vegetation is typically forested with highly variable canopy composition. *Acer rubrum* var. *trilobum*, *Nyssa sylvatica*, *Liquidambar styraciflua*, and *Quercus alba* are common and typical. Other canopy species may include *Fagus grandifolia* and *Magnolia tripetala*. Canopy coverage can be moderately dense to quite open. The subcanopy is often well-developed and characteristically includes *Ilex opaca* var. *opaca*, *Magnolia tripetala*, *Carpinus caroliniana*, and *Ostrya virginiana*.

Comments: There are physiognomically and compositionally similar forested seep systems in the Appalachian Plateau that lack abundant evergreen ericads and are apparently less sphagnous. Examples from the Ozarks (on sandstone) are apparently less species-rich and may be associated with more acidic substrates; these are also included here.

DISTRIBUTION

Range: This system is found in the Ozark and Ouachita mountains of Arkansas, possibly extending into adjacent Oklahoma and Missouri.

Divisions: 202:C

TNC Ecoregions: 38:C, 39:C

Nations: US

Subnations: AR, MO?, OK?

Map Zones: 44:C

USFS Ecomap Regions: 223A:CC, M223A:CC, M231A:CC

CONCEPT

Associations:

- *Acer rubrum* var. *trilobum* - *Liquidambar styraciflua* - *Magnolia tripetala* / *Osmunda regalis* - (*Cypripedium kentuckiense*) Forest (CEGL007444, G3?)
- *Acer rubrum* var. *trilobum* - *Nyssa sylvatica* / *Rhexia mariana* var. *interior* Forest (CEGL007822, G2?)
- *Acer rubrum* - *Fraxinus pennsylvanica* / *Carex* spp. / *Climacium americanum* Forest (CEGL002407, GU)

High-ranked species: *Plethodon caddoensis* (G2)

Environment: Examples of this system of forested seeps may be found along the bottom slopes of smaller valleys of the Ouachita Mountains of central Arkansas (where rock fractures allow water to seep out of the mountainsides), and in the riparian zones of larger creeks, sometimes extending upslope along small ephemeral drainages. The soil remains saturated to very moist throughout the year. More information is needed on the environmental details of Ozarkian examples.

Vegetation: Stands are typically forested with highly variable canopy composition. Some common and typical components are *Acer rubrum* var. *trilobum*, *Nyssa sylvatica*, *Liquidambar styraciflua*, and *Quercus alba*. Other canopy species may include *Fagus grandifolia* and *Magnolia tripetala*. The subcanopy is often well-developed and characteristically includes *Ilex opaca* var. *opaca*, *Magnolia tripetala*, *Carpinus caroliniana*, and *Ostrya virginiana*.

SOURCES

References: Comer et al. 2003, Eyre 1980

Version: 26 Jan 2006

Concept Author: T. Foti and R. Evans

Stakeholders: Midwest, Southeast

LeadResp: Southeast

G597. North-Central Flatwoods Forest

CES202.018 CENTRAL INTERIOR HIGHLANDS AND APPALACHIAN SINKHOLE AND DEPRESSION POND

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland

Diagnostic Classifiers: Lowland [Lowland]; Depressional [Pond, Sinkhole]; Muck; Mineral: W/ A-Horizon >10 cm

Concept Summary: This system of ponds and wetlands is found in the Interior Highlands of the Ozark, Ouachita, and Interior Low Plateau regions, and ranges north from the southern and central Appalachians to the northern Piedmont regions. Stands occur in basins of sinkholes or other isolated depressions on uplands. Soils are very poorly drained, and surface water may be present for extended periods of time, rarely becoming dry. Water depth may vary greatly on a seasonal basis and may be a meter deep or more in the winter. Some examples become dry in the summer. Soils may be deep (100 cm or more), consisting of peat or muck, with parent material of peat, muck or alluvium. Ponds vary from open water to herb-, shrub-, or tree-dominated. Tree-dominated examples typically contain *Quercus* species, *Platanus occidentalis*, *Fraxinus pennsylvanica*, *Acer saccharinum*, or *Nyssa* species, or a combination of these. In addition, *Liquidambar styraciflua* may be present in southern examples. *Cephalanthus occidentalis* is a typical shrub component. The herbaceous layer is widely variable depending on geography.

Comments: Many of these ponds have their geologic origin as a more-or-less complete karst collapse feature. Some of them may display this geologic origin in a more explicit manner, with definite walls and exposed limestone or dolomite at the surface ("sinkholes"). Others are more subtle, and exist as more gentle depressions, with no exposed surface geology ("depression ponds"). This includes the "sagponds" of northwestern Georgia and adjacent Alabama. Rare examples in the Ridge and Valley of Georgia (Coosa Valley) are included here. These occur on limestones or dolomites of the Chickamauga Group. Matt Elliott (pers. comm.): "I would put Ridge and Valley sagponds in with Interior Highlands ponds rather than Piedmont, as they are essentially karst features. R&V sagponds are generally pretty rare but are common in parts of Bartow County, Georgia, and a few other places. The shallower ones are dominated by willow oak, the deeper ones *Nyssa biflora*. On the Cumberland Plateau, the ones I have seen usually have sweetgum and *Nyssa sylvatica*, but I think willow oak and possibly *Nyssa biflora* might occur in some of the deeper ones. A lot of the plateau ponds seem more like swales than deep ponds, but they still may be related to underlying karst features. The Ridge and Valley sagponds may be somewhat different from those on the plateau - often deeper and with even more Coastal Plain elements; it also includes sinkhole ponds of northern New Jersey (K. Strakosch-Walz pers. comm.) and possibly ponds of the Ridge and Valley in Pennsylvania. These are very similar to Shenandoah sinkhole ponds of Virginia and are in Maryland as well (L. Sneddon pers. comm.). The only documented occurrence in Pennsylvania is the Maple Hills sinkhole in Lycoming County; "there are plenty of other sinkholes in Pennsylvania, but they have not been associated with any specific plant community" (G. Podniesinski pers. comm. 2010).

DISTRIBUTION

Range: This system is found from the Ozark and Ouachita mountains east to the southern and central Appalachians and the northern Piedmont regions (?), including the unglaciated Interior Low Plateau and Ridge and Valley. It ranges from Missouri, West Virginia, Pennsylvania, and Delaware south to Arkansas, Alabama and Georgia.

Divisions: 202:C

TNC Ecoregions: 38:C, 39:C, 44:C, 50:C, 59:C, 61:C

Nations: US

Subnations: AL, AR, DE, GA, IL, IN, KY, MD, MO, NC, NJ, OH, PA, TN, VA, WV

Map Zones: 44:C, 47:C, 48:C, 49:C, 53:C, 57:C, 61:C, 62:P, 64:P

USFS Ecomap Regions: 221F:CC, 221H:CC, 221J:CC, 223A:CC, 223D:CC, 223E:CC, 223F:CC, 231C:CC, 231D:CC, M221A:CC, M223A:CC, M231A:CC

CONCEPT

Associations:

- (*Quercus palustris*) / *Panicum rigidulum* var. *rigidulum* - *Panicum verrucosum* - *Eleocharis acicularis* Herbaceous Vegetation (CEGL007858, G1)
- *Carex barrattii* Herbaceous Vegetation (CEGL007857, G1)
- *Quercus palustris* - *Quercus bicolor* - (*Liquidambar styraciflua*) Mixed Hardwood Forest (CEGL002432, G3G4)
- *Quercus lyrata* / *Betula nigra* / *Pleopeltis polypodioides* ssp. *michauxiana* Forest (CEGL004975, G1)
- *Brasenia schreberi* Eastern Herbaceous Vegetation (CEGL004527, G4?)
- *Pontederia cordata* - *Sagittaria graminea* - *Sagittaria latifolia* Semipermanently Flooded Herbaceous Vegetation (CEGL004986, G1G2Q)
- *Quercus lyrata* - *Quercus* (*palustris*, *phellos*) - *Liquidambar styraciflua* - (*Populus heterophylla*) Forest (CEGL004421, G2G3)
- *Typha latifolia* Southern Herbaceous Vegetation (CEGL004150, G5)
- *Quercus bicolor* - *Fraxinus pennsylvanica* / *Carex* spp. Forest (CEGL004422, G1G2)
- *Eleocharis microcarpa* - *Juncus repens* - *Rhynchospora corniculata* - (*Mecardonia acuminata*, *Proserpinaca* spp.) Herbaceous Vegetation (CEGL004748, G2G3)
- *Nelumbo lutea* Herbaceous Vegetation (CEGL004323, G4?)
- *Cephalanthus occidentalis* - (*Salix nigra*, *Quercus lyrata*) Karst Depression Shrubland (CEGL008439, G1Q)
- *Quercus alba* - *Nyssa sylvatica* Sandstone Ridgetop Depression Forest (CEGL008440, G2Q)
- *Quercus palustris* Pond Forest (CEGL007809, G2)
- *Scirpus cyperinus* - *Panicum rigidulum* - *Rhynchospora corniculata* - (*Dulichium arundinaceum*) Herbaceous Vegetation (CEGL004719, G2G3)
- *Orontium aquaticum* - *Schoenoplectus subterminalis* - *Eriocaulon aquaticum* Herbaceous Vegetation (CEGL007859, G1)
- *Quercus phellos* Seasonally Flooded Ozark Pond Forest (CEGL007402, GNR)
- *Quercus alba* - *Nyssa sylvatica* Seasonally Flooded Forest (CEGL008473, GNR)
- *Quercus lyrata* Pond Forest (CEGL004642, G1G3)
- *Nyssa aquatica* / *Cephalanthus occidentalis* Pond Forest (CEGL004712, G1?)
- *Nyssa biflora* / *Cephalanthus occidentalis* - *Lyonia lucida* Sagpond Forest (CEGL004116, G1G2)
- *Acer* (*rubrum*, *saccharinum*) - *Fraxinus pennsylvanica* / *Ilex verticillata* / *Osmunda regalis* Forest (CEGL006630, GNR)
- *Ceratophyllum demersum* - *Stuckenia pectinata* Herbaceous Vegetation (CEGL004528, G4G5)
- *Scirpus cyperinus* - *Dulichium arundinaceum* / *Sphagnum* spp. Herbaceous Vegetation (CEGL004134, G1Q)
- *Panicum hemitomon* - *Dulichium arundinaceum* Herbaceous Vegetation (CEGL004126, G1)
- *Liquidambar styraciflua* - *Acer rubrum* / *Carex* spp. - *Sphagnum* spp. Forest (CEGL007388, G2G3Q)
- *Quercus palustris* - (*Quercus bicolor*) / *Carex crinita* / *Sphagnum* spp. Forest (CEGL002406, G3?)

- *Carex aquatilis* - *Dulichium arundinaceum* Herbaceous Vegetation (CEGL008542, G1?)
- *Sparganium americanum* - (*Sparganium erectum* ssp. *stoloniferum*) - *Epilobium leptophyllum* Herbaceous Vegetation (CEGL004510, G3?)
- *Saccharum baldwinii* - *Calamagrostis coarctata* - *Panicum rigidulum* - *Rhynchospora capitellata* Herbaceous Vegetation (CEGL004750, G2G3)
- *Ludwigia peploides* Herbaceous Vegetation (CEGL007835, G4G5)
- *Cephalanthus occidentalis* / *Hibiscus moscheutos* ssp. *moscheutos* Depression Pond Shrubland (CEGL004742, G3?)
- *Dasiphora fruticosa* ssp. *floribunda* / *Rhynchospora capillacea* - *Scleria verticillata* Shrub Herbaceous Vegetation (CEGL006356, G1)
- *Vaccinium oxycoccos* - (*Vaccinium macrocarpon*) / *Rhynchospora alba* - *Drosera rotundifolia* / *Sphagnum* spp. Dwarf-shrubland (CEGL007856, G2)
- *Quercus phellos* - *Liquidambar styraciflua* / *Chasmanthium laxum* Cumberland / Southern Ridge and Valley Forest (CEGL008441, G3)
- *Phalaris arundinacea* Eastern Herbaceous Vegetation (CEGL006044, GNA)
- *Carex comosa* - *Carex decomposita* - *Dulichium arundinaceum* - *Lycopus rubellus* Herbaceous Vegetation (CEGL002413, G3G4)
- *Platanus occidentalis* - *Fraxinus pennsylvanica* - *Ulmus americana* / *Cornus sericea* Forest (CEGL006901, G2G3)
- *Fraxinus pennsylvanica* - *Acer saccharinum* - *Quercus bicolor* / *Boehmeria cylindrica* Forest (CEGL006634, GNR)
- *Boltonia asteroides* var. *asteroides* - *Symphytotrichum racemosum* - *Mentha arvensis* Herbaceous Vegetation (CEGL006900, G1G2)
- *Leersia oryzoides* - *Boehmeria cylindrica* - *Ranunculus flabellaris* Herbaceous Vegetation (CEGL006903, GNR)
- *Nuphar advena* - *Nymphaea odorata* Herbaceous Vegetation (CEGL002386, G4G5)
- *Salix nigra* - *Acer (rubrum, saccharinum)* / *Alnus serrulata* - *Cephalanthus occidentalis* Forest (CEGL007703, G5)
- *Carex jorii* - *Eleocharis tenuis* var. *verrucosa* - *Juncus* spp. - *Panicum rigidulum* Interior Highlands Channel Scar Depression Wooded Herbaceous Vegetation (CEGL007116, G2?)

High-ranked species: *Aureolaria patula* (G3), *Boltonia montana* (G1G2), *Canis rufus* (G1Q), *Carex decomposita* (G3G4), *Fimbristylis perpusilla* (G2), *Glyptemys muhlenbergii* (G3), *Helenium virginicum* (G3), *Isoetes virginica* (G1), *Muhlenbergia torreyana* (G3), *Myotis austroriparius* (G3G4), *Platanthera leucophaea* (G2G3), *Potamogeton hillii* (G3), *Potamogeton tennesseensis* (G2G3), *Schoenoplectus hallii* (G2G3), *Scirpus ancistrochaetus* (G3)

Environment: Examples of this system occur in basins of sinkholes or other isolated depressions on uplands. Soils are very poorly drained, and surface water may be present for extended periods of time, rarely becoming dry. Water depth may vary greatly on a seasonal basis, and may be a meter deep or more in the winter. Some examples become dry in the summer. Soils may be deep (100 cm or more), consisting of peat or muck, with parent material of peat, muck or alluvium.

Vegetation: Ponds vary from open water to herb-, shrub-, or tree-dominated types. Tree-dominated examples typically contain *Quercus* species, *Platanus occidentalis*, *Fraxinus pennsylvanica*, *Acer saccharinum*, or *Nyssa* species, or a combination of these. In addition, *Liquidambar styraciflua* may be present in southern examples. *Cephalanthus occidentalis* is a typical shrub component. The herbaceous layer is widely variable depending on geography.

Dynamics: Water depth may vary greatly on a seasonal basis, and may be a meter deep or more in the winter. Some examples become dry in the summer.

SOURCES

References: Comer et al. 2003, Evans 1991, Eyre 1980, M. Elliott pers. comm., Wharton 1978

Version: 26 Jan 2006

Stakeholders: East, Midwest, Southeast

Concept Author: M. Pyne, S. Menard, D. Faber-Langendoen

LeadResp: Midwest

CES202.700 NORTH-CENTRAL INTERIOR WET FLATWOODS

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland

National Mapping Codes: EVT 2518; ESLF 9186; ESP 1518

Concept Summary: This small-patch system is found throughout the northern glaciated Midwest ranging east into Lower New England and the Champlain Valley. It usually occurs on somewhat poorly drained uplands or in depressions associated with glacial features such as tillplains, lakeplains or outwash plains. Soils often have an impermeable or nearly impermeable clay layer that can create a shallow, perched water table. Saturation can vary, with ponding common during wetter seasons, and drought possible during the summer and autumn months. Microtopography and fluctuating moisture levels can lead to complexes of forest upland and wetland species occurring within this system. *Quercus palustris* and/ or *Quercus bicolor* typically dominate the wetter portions and are often associated with *Acer rubrum*. *Quercus alba*, *Quercus rubra*, and *Fagus grandifolia* are common in the better-drained areas. *Carya ovata* is a characteristic tree in the Champlain Valley. *Liquidambar styraciflua*, *Nyssa sylvatica*, *Fraxinus americana*, and *Fraxinus pennsylvanica* are also common associates, though their occurrence varies somewhat by region. Understory herbaceous and shrub species present in examples of this system can vary. Stands with more dense tree cover have less shrub and herbaceous cover, while

those with moderate tree canopy cover tend to have a dense understory. Some common species in the wetter portions include *Carex* spp., *Osmunda cinnamomea*, *Cephalanthus occidentalis*, *Alnus* spp., and *Ilex* spp. Flooding, drought and fire can influence this system.

Comments: These are mostly north of the glacial line, but one association is in the Interior Low Plateau and that placement may need to be reviewed. Some examples in Michigan, Indiana, Ohio, Vermont, and southern Ontario are dominated by *Fagus grandifolia*, oak (primarily *Quercus alba* and *Quercus rubra*) and maple species (*Acer* spp.). Vermont's Valley Clayplain Forest is placed here tenuously as it has more of an upland component and occurs at a local matrix scale, not as a small-patch element.

DISTRIBUTION

Range: This system is found in the northern Midwest, southern Ontario, and portions of the northeastern U.S.

Divisions: 201:P, 202:C

TNC Ecoregions: 36:C, 44:C, 45:C, 47:?, 48:C, 49:P, 59:P, 61:C, 64:C

Nations: CA, US

Subnations: CT, IA, IL, IN, MA, MI, MO, NY, OH, ON, PA, VT

Map Zones: 41:?, 42:C, 43:C, 44:P, 47:C, 49:?, 50:?, 51:C, 52:C, 53:P, 61:C, 62:P, 63:C, 64:P, 65:C

USFS Ecomap Regions: 211E:CC, 211F:CP, 221A:CC, 221B:CP, 222I:CP, 222Jh:CCC, 222Ua:CCC, 222Ue:CC?

CONCEPT

Associations:

- *Quercus palustris* - *Quercus bicolor* - (*Liquidambar styraciflua*) Mixed Hardwood Forest (CEGL002432, G3G4)
- *Quercus palustris* - *Quercus bicolor* - *Acer rubrum* Flatwoods Forest (CEGL005037, G2G3)
- *Quercus palustris* - (*Quercus stellata*) - *Quercus pagoda* / *Isoetes* spp. Forest (CEGL002101, G2G3)
- *Quercus palustris* - (*Quercus bicolor*) - *Acer rubrum* / *Vaccinium corymbosum* / *Osmunda cinnamomea* Forest (CEGL006240, GNR)
- *Fagus grandifolia* - *Quercus alba* - (*Quercus michauxii*) - *Acer rubrum* Flatwoods Forest (CEGL005015, G3)
- *Quercus alba* - *Quercus stellata* - *Quercus velutina* / *Cornus florida* / *Andropogon gerardii* Woodland (CEGL006434, G1G3)
- *Cephalanthus occidentalis* / *Carex* spp. Northern Shrubland (CEGL002190, G4)
- *Fagus grandifolia* - *Acer saccharum* - *Quercus bicolor* - *Acer rubrum* Flatwoods Forest (CEGL005173, G2G3)
- *Quercus palustris* - *Quercus bicolor* - *Nyssa sylvatica* - *Acer rubrum* Sand Flatwoods Forest (CEGL002100, G2?)
- *Fagus grandifolia* - *Acer rubrum* / *Vaccinium corymbosum* Forest (CEGL006072, GNR)
- *Quercus alba* - *Acer rubrum* - *Carya ovata* / *Viburnum acerifolium* / *Waldsteinia fragarioides* Forest (CEGL006122, GNR)

High-ranked species: *Euphyes dukesi* (G3)

Environment: This system usually occurs on poorly drained uplands or in depressions associated with glacial features such as tillplains, lakeplains or outwash plains. Soils often have an impermeable or nearly impermeable clay layer that can create a shallow, perched water table. Saturation can vary, with ponding common during wetter seasons, and drought possible during the summer and autumn months. These fluctuating moisture levels can lead to complexes of forest upland and wetland species occurring within this system.

Vegetation: *Quercus palustris* and/or *Quercus bicolor* typically dominate the wetter portions and are often associated with *Acer rubrum*. *Quercus alba*, *Quercus rubra*, *Fagus grandifolia*, and *Acer saccharum* are common in the better-drained areas, seen in some examples around the southern Great Lakes and Lake Champlain. *Carya ovata* is a characteristic tree in the Champlain Valley. *Liquidambar styraciflua*, *Nyssa sylvatica*, *Fraxinus americana*, and *Fraxinus pennsylvanica* are also common associates, though their occurrence varies somewhat by region. Understory herbaceous and shrub species present in examples of this system can vary. Stands with more dense tree cover have less shrub and herbaceous cover, while those with moderate tree canopy cover tend to have a dense understory. Some common species include *Carex* spp., *Osmunda cinnamomea*, *Cephalanthus occidentalis*, *Alnus* spp., and *Ilex* spp. In the clayplain forests of Vermont, characteristic herbs include *Waldsteinia fragarioides* and *Moehringia lateriflora* (= *Arenaria lateriflora*).

Dynamics: Flooding, drought and fire can influence this system. Invasive shrubs are a problem in some areas. Very few examples remain as almost all have been converted to agriculture.

SOURCES

References: Braun 1950, Comer et al. 2003, Eyre 1980

Version: 05 May 2008

Concept Author: S. Menard

Stakeholders: Canada, East, Midwest, Southeast

LeadResp: Midwest

G654. South-Central Flatwoods & Pond Forest

CES202.454 INTERIOR HIGHLANDS UNGLACIATED FLATWOODS

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Forest and Woodland

Spatial Scale & Pattern: Small patch, Large patch, Matrix

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland

Diagnostic Classifiers: Forest and Woodland (Treed); Hardpan; Broad-Leaved Deciduous Tree

Concept Summary: This system represents hardwood- or pine-hardwood-dominated flatwoods of the Ozarks, Arkansas Valley, and Ouachitas of Arkansas, adjacent Missouri and possibly Oklahoma. Sites are high, fairly level and generally unflooded but seasonally saturated. There is some local variability in the expression of this system along a hydrologic/microtopographic gradient. The elevated ridges or pimple mounds are better drained and retain less moisture than do the lower areas, although both occur in a tight local mosaic. The soils appear to have well-developed subsurface hardpans, the impermeability of which contributes to shallowly perched water tables during portions of the year when precipitation is greatest and evapotranspiration is lowest. Soil moisture fluctuates widely throughout the growing season, from saturated to very dry, a condition sometimes referred to as xerohydric. Fire was an important natural process in this system, and well-burned examples tend to be relatively open-canopied with well-developed herbaceous layers.

DISTRIBUTION

Range: This system is found in the Ozarks, Arkansas Valley, and Ouachitas of Arkansas, adjacent Missouri and possibly Oklahoma

Divisions: 202:C

TNC Ecoregions: 38:C, 39:C

Nations: US

Subnations: AR, MO, OK?

Map Zones: 44:C

USFS Ecomap Regions: 223A:CC, 231Ee:CCC, 231Gc:CCC, M223A:CC, M231A:CC

CONCEPT

Associations:

- *Quercus stellata* / *Cinna arundinacea* Flatwoods Forest (CEGL002405, G2G3)
- *Quercus phellos* - *Quercus similis* Flatwoods Forest (CEGL007112, G3?)

Environment: This system occupies level or nearly level ground on upland plains, flat ridgetops, and floodplain terraces. Soils are usually deep but with an impermeable or slowly permeable hardpan or fragipan which creates a shallow perched water table. It is seasonally wet in winter and spring, becoming very dry in summer and autumn. Sites are high, fairly level and generally not flooded, but seasonally saturated. There is some local variability in the expression of this system along a hydrologic/microtopographic gradient. The elevated ridges or pimple mounds are better drained and retain less moisture than do the lower areas, although both occur in a tight local mosaic. The soils appear to have well-developed subsurface hardpans, the impermeability of which contributes to shallowly perched water tables during portions of the year when precipitation is greatest and evapotranspiration is lowest. Soil moisture fluctuates widely throughout the growing season, from saturated to very dry, a condition sometimes referred to as xerohydric. Fire was an important natural process in this system, and well-burned examples tend to be relatively open-canopied with well-developed herbaceous layers (Nelson 2005).

Vegetation: These are hardwood- or pine-hardwood-dominated forests or woodlands. *Quercus phellos* is typically dominant or codominant except in the occurrences that are seasonally driest, where *Quercus stellata* is dominant. *Pinus echinata* may be dominant or codominant with *Quercus phellos* in sites of intermediate moisture. The medium tree canopy is somewhat open-grown with a somewhat open to mostly closed canopy (70-90% cover). The understory is poorly developed. Ground cover is variable with a low to medium diversity consisting of plants characteristic of dry soils on higher ground and wet soils in depressions.

Dynamics: Fire is of variable importance, i.e., very frequent and important in sites from very dry to moderately dry, but less frequent and less important on the wettest sites, where long-duration saturation leads to shallow rooting depths and consequent susceptibility to windthrow. Therefore, communities of wettest sites are likely to be closed forest and uneven-aged whereas intermediate to very dry sites may be more likely to be woodland, perhaps even-aged.

SOURCES

References: Foti pers. comm., NatureServe Ecology - Southeastern U.S. unpubl. data, Nelson 1985, Nelson 2005, Southeastern Ecology Working Group n.d.

Version: 30 Apr 2012

Concept Author: M. Pyne and T. Foti

Stakeholders: Midwest, Southeast

LeadResp: Southeast

CES203.479 SOUTH-CENTRAL INTERIOR / UPPER COASTAL PLAIN FLATWOODS

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Forest and Woodland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland

Diagnostic Classifiers: Forest and Woodland (Treed); Pimple mounds; Broad-Leaved Deciduous Tree

National Mapping Codes: EVT 2326; ESLF 4132; ESP 1326

Concept Summary: This system represents hardwood-dominated "xerohydric flatwoods" of limited areas of the most inland portions of the East Gulf Coastal Plain in western Kentucky, as well as in the nearby Shawnee Hills in the western Interior Low Plateau. The core of the area from which this system was initially described is referred to as the Jackson Purchase or "Jackson Plain," where these

areas have long been recognized as a distinctive subdivision within this region (Davis 1923, Bryant and Martin 1988). There is some local variability in the expression of this system along a hydrologic/microtopographic gradient. The elevated ridges are composed of somewhat coarser-textured soils and retain less moisture than do the lower areas, although both occur in a tight local mosaic. The soils appear to have well-developed subsurface hardpans, the impermeability of which contributes to shallowly perched water tables during portions of the year when precipitation is greatest and evapotranspiration is lowest (not due to overbank flooding). Thus, soil moisture fluctuates widely throughout the growing season, from saturated to very dry, a condition sometimes referred to as xerohydric (Evans 1991). Fire was an important natural process in this system, and well-burned examples tend to be relatively open-canopied with well-developed herbaceous layers (M. Evans pers. comm.).

Comments: The component associations are poorly known and described. More work is needed to clarify which types are present.

DISTRIBUTION

Range: This system occurs in limited areas of the most inland portions of the East Gulf Coastal Plain in western Kentucky and adjacent Tennessee (the "Jackson Purchase" or "Jackson Plain" region; 222Cb; 74b in part), as well as in the nearby "Shawnee Hills" of the Interior Low Plateau (222Dh, 222Di; 72c) of Kentucky and adjacent Indiana.

Divisions: 203:C

TNC Ecoregions: 43:C, 44:C

Nations: US

Subnations: IL?, IN, KY, TN

Map Zones: 46:P, 47:C, 49:?

USFS Ecomap Regions: 223D:CC, 223E:CC, 231H:CC

CONCEPT

Associations:

- *Quercus stellata* / *Cinna arundinacea* Flatwoods Forest (CEGL002405, G2G3)
- *Quercus stellata* / (*Danthonia spicata*, *Croton willdenowii*) Woodland (CEGL005057, G1)

Environment: Examples of this system occur along the northeastern flank of the Upper East Gulf Coastal Plain ecoregion where loess deposits thin out and gravelly or sandy soils predominate. Examples occur on relatively high flat areas that are not directly affected by overbank flooding. These environments include ancient Quaternary or Tertiary post-glacial meltwater lakebeds and high terraces of the Upper Gulf Coastal Plain. The most typical soil is Okaw Silt Loam. The same system is found in the Shawnee Hills of Kentucky (M. Evans pers. comm. 2006). The lakes were originally formed by glacial damming of the Ohio River.

Vegetation: Stands of this system are dominated by *Quercus stellata*, a somewhat fire-tolerant oak. In addition, *Quercus alba*, *Carya ovata*, *Carya glabra*, and *Quercus velutina* may be present. The presence of *Quercus falcata* indicates longer fire-return times. The presence of *Quercus imbricaria* indicates that the stands were formerly more open. *Pinus* spp. are not prevalent in this area, but could invade from nearby plantations. Herbaceous cover is sparse to moderate; leaf litter is the dominant ground cover. Some shrubs include *Crataegus viridis*, *Ilex decidua*, and *Ulmus alata*. Characteristic grasses could include *Schizachyrium scoparium*, *Sorghastrum nutans*, and *Andropogon* spp. Some other typical herbs include *Manfreda virginica*, *Croton willdenowii*, *Danthonia spicata*, *Porteranthus stipulatus*, and *Pycnanthemum tenuifolium* (Hendricks et al. 1991). Lower areas (drainage ways and depressions) have *Quercus michauxii*, *Quercus pagoda*, *Quercus phellos*, *Liquidambar styraciflua*, or even *Taxodium distichum*. Local herb dominance in depressions is of wetland species such as *Juncus* spp. and *Carex* spp. For this related and possibly juxtaposed wetland vegetation, see South-Central Interior / Upper Coastal Plain Wet Flatwoods (CES203.480).

SOURCES

References: Bryant and Martin 1988, Comer et al. 2003, Davis 1923, Evans 1991, Eyre 1980, Hendricks et al. 1991, M. Evans pers. comm., NatureServe Ecology - Southeastern U.S. unpubl. data

Version: 18 Apr 2006

Concept Author: R. Evans and M. Evans

Stakeholders: Midwest, Southeast

LeadResp: Southeast

CES203.480 SOUTH-CENTRAL INTERIOR / UPPER COASTAL PLAIN WET FLATWOODS

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland

Diagnostic Classifiers: Forest and Woodland (Treed); Extensive Wet Flat; Broad-Leaved Deciduous Tree

National Mapping Codes: EVT 2457; ESLF 9126; ESP 1457

Concept Summary: This system represents predominantly wet flatwoods of limited areas of the most inland portions of the East Gulf Coastal Plain in western Kentucky, as well as related broad, flat areas of the western Interior Low Plateau. This part of the Coastal Plain is referred to as the Jackson Purchase or "Jackson Plain." Flatwoods have long been recognized as a distinctive subdivision within this region (Davis 1923, Bryant and Martin 1988). Examples in the Pennyroyal Plain (of the western Interior Low Plateau) have been known for many years and referred to as "ponywoods" or "crawfishy land" (Chester et al. 1995). They are also known from the Shawnee Hills of Kentucky, on Periglacial lakebeds (M. Evans pers. comm. 2006), and from the Moulton Valley of Alabama (A. Schotz pers. comm. 2006). They tend to be confined to relatively small areas near the eastern flank of the region where

loess deposits thin out. Unlike South-Central Interior / Upper Coastal Plain Flatwoods (CES203.479) of the same general region (which is typified by complex microtopography), this system occupies broad flats underlain by fragipans. These fragipans impede the downward migration of water, resulting in wet conditions for portions of the year. Fire was an important natural process in this system, probably maintaining relatively open-canopied stands (M. Evans pers. comm.). Stands are dominated by hardwood trees, including *Quercus* spp., *Liquidambar styraciflua*, *Carya* spp., and *Acer rubrum* (Chester et al. 1995). Related wet flatwoods are apparently present in the Moulton Valley of Alabama and these are provisionally placed here.

Comments: The primary range of this system is limited areas of the "Jackson Purchase" or "Jackson Plain" of Kentucky and possibly related areas in adjacent western Tennessee, as well as related broad, flat areas of the western Interior Low Plateau. According to Bryant and Martin (1988) the "Flatwoods" portion of the Jackson Purchase (which is primarily where the "Wet Flatwoods" are located in that area) occupies less than 2% of the total area, but localized occurrences could have been present in other parts of the region. These apparently related wet flatwoods in the western end of the Moulton Valley of Alabama are found in northeastern Franklin and extreme western Lawrence counties, from 10 to 20 km east of Russellville. More information is needed. In Alabama, this system is apparently found in the Moulton Valley region (A. Schotz pers. comm. 2006), which is technically part of TNC Ecoregion 50 but ambiguously placed there.

DISTRIBUTION

Range: The primary range of this system is limited areas of the "Jackson Purchase" or "Jackson Plain" of Kentucky and possibly related areas in adjacent western Tennessee, as well as related broad, flat areas of the western Interior Low Plateau. It is assumed to cross the Ohio River into adjacent Indiana. It has been discerned from wetland modeling and confirmed by observation in the Moulton Valley of Alabama.

Divisions: 203:C

TNC Ecoregions: 43:C, 44:C, 50:C

Nations: US

Subnations: AL, IL?, IN?, KY, TN

Map Zones: 46:P, 47:C, 48:C, 49:?

USFS Ecomap Regions: 223D:CC, 223E:CC, 223G:CC, 231B:CC, 231H:CC

CONCEPT

Associations:

- *Quercus palustris* - (*Quercus stellata*) - *Quercus pagoda* / *Isoetes* spp. Forest (CEGL002101, G2G3)
- *Quercus phellos* - (*Quercus lyrata*) / *Carex* spp. - *Leersia* spp. Forest (CEGL002102, G3G4Q)
- *Quercus falcata* Flatwoods Forest (CEGL004412, G2?)

Environment: These flatwoods have long been recognized as the primary vegetation type of a distinctive subdivision within the Upper East Gulf Coastal Plain region (Davis 1923, Bryant and Martin 1988), as well as related areas of the western Interior Low Plateau. Within the "Jackson Plain" portion of the Upper East Gulf Coastal Plain, these flatwoods tend to be confined to relatively small areas near the eastern flank of the "Jackson Plain" region where the loess deposits thin out. Unlike drier Post Oak Flatwoods of these areas (which are typified by microtopographic variation), this system occupies broad flats underlain by fragipans. These fragipans impede the downward migration of water resulting in wet conditions for portions of the year. In the Jackson Plain area the soils include Henry silt loam, Routon silt loam (Bryant and Held 2001) and Calloway silt loam (Karathanasis et al. 2003). Fire is probably relatively infrequent in this system (M. Evans pers. comm.). In the Pennyroyal Plain, this system occurs on upland flats and depressions with poor drainage, underlain by limestone; soils include Robertsville silt loam (Chester et al. 1995) and Henry silt loam (M. Evans pers. comm.).

Vegetation: Stands are typically dominated by various combinations of oaks and other hardwoods, including *Quercus pagoda*, *Quercus stellata*, *Carya ovata*, *Prunus serotina*, *Diospyros virginiana*, *Ulmus alata*, *Ulmus americana*, *Quercus palustris* (Bryant 1999), *Quercus michauxii*, *Liquidambar styraciflua*, *Carya* spp., *Nyssa sylvatica*, and *Acer rubrum* (Chester et al. 1995). Most stands of this system have been severely altered or destroyed, and the characteristic herbs are poorly known. *Campsis radicans* may be found, along with *Carex* spp., including *Carex leptalea* and *Carex cherokeensis*. Other herbs may include *Leersia* spp. and *Cardamine bulbosa*. *Quercus phellos* and/or *Quercus lyrata* may also be present in stands of this system in Kentucky (M. Evans pers. comm. 2006). Some stands placed here are dominated by *Quercus falcata* (e.g., at Shiloh National Military Park), others (e.g., in the Moulton Valley of Alabama) by a combination of *Quercus phellos* and *Quercus nigra* (A. Schotz pers. comm. 2006).

Dynamics: Most historic occurrences have been cleared, drained and tilled, and remaining sites are small and degraded. Fire was an important natural process in this system, probably maintaining relatively open-canopied stands (M. Evans pers. comm.). Under such conditions *Andropogon gerardii* and *Chasmanthium* spp. may have dominated the herbaceous ground cover.

SOURCES

References: Bryant 1999, Bryant and Held 2001, Bryant and Martin 1988, Chester et al. 1995, Comer et al. 2003, Davis 1923, Evans 1991, Eyre 1980, Hendricks et al. 1991, Karathanasis et al. 2003, M. Evans pers. comm., NRCS 1996, NatureServe Ecology - Southeastern U.S. unpubl. data, Schotz pers. comm.

Version: 23 May 2008

Concept Author: R. Evans and M. Evans, mod. M. Pyne

Stakeholders: Midwest, Southeast

LeadResp: Southeast

M504. NORTHERN SWAMP FOREST**G045. Northern Conifer & Hardwood Acidic Swamp****CES202.604 NORTH-CENTRAL APPALACHIAN ACIDIC SWAMP****Primary Division:** Central Interior and Appalachian (202)**Land Cover Class:** Woody Wetland**Spatial Scale & Pattern:** Large patch**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Wetland**Diagnostic Classifiers:** Forest and Woodland (Treed); Extensive Wet Flat; Needle-Leaved Tree; 30-180-day hydroperiod

Concept Summary: These swamps are distributed from central New England through the Central Appalachians south to Virginia and west to Ohio. They are found at low to mid elevations (generally <700 m) in basins or on gently sloping seepage lowlands. The acidic substrate is mineral soil, often with a component of organic muck; if peat is present, it usually forms an organic epipedon over the mineral soil rather than a true peat substrate (although peat layers up to 1 m deep have been found in some of these swamps). *Tsuga canadensis* is usually present and may be dominant. It is often mixed with deciduous wetland trees such as *Acer rubrum* or *Nyssa sylvatica*. *Sphagnum* is an important component of the bryoid layer. Basin swamps tend to be more nutrient-poor and less species-rich than seepage swamps; in some settings, the two occur adjacent to each other with the basin swamp vegetation surrounded by seepage swamp vegetation on its upland periphery.

Comments: This system excludes swamps with *Chamaecyparis thyoides*, a tree more characteristic of the Coastal Plain but which sometimes occurs inland. See Northern Atlantic Coastal Plain Basin Peat Swamp (CES203.522). Some examples of this system may appear similar to Southern and Central Appalachian Bog and Fen (CES202.300) or North-Central Interior and Appalachian Acidic Peatland (CES202.606); those systems are distinguished by their deeper peat substrate and overall partly forested character compared to the shallower organic soil and generally forested nature of the present system. Wetlands on the Allegheny Plateau, at higher elevations, are a distinct system, High Allegheny Wetland (CES202.069). There are many species with this type, but it is distinguished by occurring as a mosaic of open wetlands and smaller forest patches with a distinctive hydrology.

DISTRIBUTION**Range:** This system occurs from central New England south to western Virginia (the Central Appalachians region) and west to Ohio.**Divisions:** 202:C**TNC Ecoregions:** 49:C, 52:C, 59:C, 60:C, 61:C, 63:C**Nations:** US**Subnations:** CT, MA, MD, NH, NJ, NY, OH, PA, RI, VA, VT**Map Zones:** 53:C, 60:C, 61:C, 62:C, 63:C, 64:C, 65:C, 66:P**USFS Ecomap Regions:** 211E:CP, 211F:CC, 211G:CC, 211I:CC, 211J:CC, 221A:CC, 221B:CC, 221D:CC, 222I:CC, M211A:CP, M211B:CC, M211C:CC, M221A:CC**CONCEPT****Associations:**

- *Acer rubrum* / *Carex stricta* - *Onoclea sensibilis* Woodland (CEGL006119, G3G5)
- *Betula alleghaniensis* - *Acer rubrum* - (*Tsuga canadensis*, *Abies balsamea*) / *Osmunda cinnamomea* Forest (CEGL006380, G4?)
- *Picea rubens* / *Rhododendron maximum* - *Kalmia latifolia* / *Eriophorum virginicum* / *Sphagnum* spp. Forest (CEGL006588, G2G3)
- *Picea rubens* - (*Tsuga canadensis*) / *Rhododendron maximum* Saturated Forest (CEGL006277, G2?)
- *Acer rubrum* - *Nyssa sylvatica* - *Betula alleghaniensis* / *Sphagnum* spp. Forest (CEGL006014, G3)
- *Tsuga canadensis* - *Betula alleghaniensis* / *Veratrum viride* - *Carex scabrata* - *Oclemena acuminata* Forest (CEGL008533, G2)
- *Acer rubrum* - *Fraxinus (pennsylvanica, americana)* / *Lindera benzoin* / *Symplocarpus foetidus* Forest (CEGL006406, G4G5)
- *Tsuga canadensis* - *Betula alleghaniensis* / *Ilex verticillata* / *Sphagnum* spp. Forest (CEGL006226, G5)
- *Acer rubrum* / *Nemopanthus mucronatus* - *Vaccinium corymbosum* Forest (CEGL006220, G4G5)
- *Tsuga canadensis* / *Rhododendron maximum* / *Sphagnum* spp. Forest (CEGL006279, G4?)
- *Acer rubrum* - *Nyssa sylvatica* High Allegheny Plateau, Central Appalachian Forest (CEGL006132, GNR)
- *Acer rubrum* / *Rhododendron viscosum* - *Clethra alnifolia* Forest (CEGL006156, GNR)
- *Acer rubrum* / *Carex lacustris* Woodland (CEGL006105, GNR)
- *Acer rubrum* - *Nyssa sylvatica* / *Ilex verticillata* - *Vaccinium fuscatum* / *Osmunda cinnamomea* Forest (CEGL007853, G2)

High-ranked species: *Helonias bullata* (G3)**SOURCES****References:** Comer et al. 2003, Eyre 1980, Fleming et al. 2005**Version:** 05 May 2008**Concept Author:** S.C. Gawler**Stakeholders:** East, Midwest, Southeast**LeadResp:** East

G046. Northern Conifer & Hardwood Alkaline Swamp**CES201.726 GREAT LAKES WOODED DUNE AND SWALE****Primary Division:** Laurentian-Acadian (201)**Land Cover Class:** Mixed Upland and Wetland**Spatial Scale & Pattern:** Large patch**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland**Diagnostic Classifiers:** Forest and Woodland (Treed); Dune (Substrate); Glaciated; Sand Soil Texture; 30-180-day hydroperiod; Coastal Dune Mosaic**National Mapping Codes:** EVT 2466; ESLF 9135; ESP 1466

Concept Summary: This system is found in nearly 100 occurrences throughout the Great Lakes shorelines of the United States and Canada. It consists of a foredune, followed by a series of low to high dunes (uplands) and swales (wetlands). The system is often best developed where post-glacial streams entered an embayment and provide a dependable sand source. The combination of along-shore currents, waves, and winds form foredunes along the shoreline. The foredunes of most dune-and-swale complexes are commonly 1-2 m high, with *Ammophila breviligulata*, *Calamovilfa longifolia*, *Salix serissima*, *Salix cordata*, and *Populus balsamifera* most common. The swale immediately behind the foredune is influenced by short-term variation in lake levels and can be partially or occasionally completely filled by dune sands following major storm events. Species common to this first swale include *Juncus balticus*, *Juncus pelocarpus*, *Juncus nodosus*, *Eleocharis acicularis*, and *Schoenoplectus americanus* (= *Scirpus americanus*). Occasionally, such swales may contain lake-influenced, calcareous sands and may contain moderately alkaline indicators.

A low dune field with more advanced plant succession often follows the first open dunes and swales. *Pinus banksiana*, *Pinus strobus*, and *Pinus resinosa* often form a scattered overstory canopy, while *Juniperus communis*, *Juniperus horizontalis*, *Arctostaphylos uva-ursi*, and *Koeleria macrantha* form a scattered ground layer. Following the dune-field zone, both dunes and swales are typically forested. Moist swales are often forested, and soil organic material has often begun to accumulate. *Thuja occidentalis*, *Alnus incana*, *Salix* spp., and *Acer rubrum* dominate the partial overstory canopy and understory. In contrast to the dry or moist swales, wetter swales (where standing water is present through most of the year) may be dominated by Carices, such as *Carex aquatilis* and *Carex stricta*. Forested beach ridges, with soils of medium to coarse sand, tend to be dominated by species common to dry-mesic and mesic northern forest. Complexes located in embayments protected from prevailing winds tend to be formed entirely of low, water-lain beach ridges. As a result, even the beach ridges within these complexes support wetland vegetation.

Six major subtypes of Great Lakes Dune and Swale were described for Michigan, including the Lake Superior high dune type, the Lake Superior low dune type, the North Lake Michigan high dune type, Northern Lake Huron-Lake Michigan low dune type, the Southern Lake Huron type, and the Northern Great Lakes low dune type. These subtypes represent patterns of floristic variation resulting from latitude and sand dune/beach ridge characteristics that constrain floristic and structural attributes. High dune types may support predominantly upland vegetation, while low dune types may support predominantly wetland vegetation.

Comments: Six major subtypes of Great Lakes Dune and Swale were described for Michigan, including the Lake Superior high dune type, the Lake Superior low dune type, the North Lake Michigan high dune type, Northern Lake Huron-Lake Michigan low dune type, the Southern Lake Huron type, and the Northern Great Lakes low dune type. These subtypes represent patterns of floristic variation resulting from latitude and sand dune/beach ridge characteristics that constrain floristic and structural attributes.

This system has rather strong variation between northern and southern Great Lakes examples (north and south of Bailey's 210-220 division line). Those occurring along the southern Lake Michigan shoreline of Indiana and Illinois have been altered significantly, but likely reflect a distinct ecological system type with oak woodland and savanna on beach ridges and wet prairie in swales.

DISTRIBUTION

Range: This system occurs throughout the Great Lakes shorelines of the United States and Canada. In Pennsylvania, this is only on Presque Isle.

Divisions: 201:C, 202:C**TNC Ecoregions:** 48:C**Nations:** CA, US**Subnations:** IL, IN, MI, MN, NY, OH?, ON, PA, WI**Map Zones:** 41:C, 49:C, 50:C, 51:C, 52:C, 62:C, 63:C, 64:C**USFS Ecomap Regions:** 211Ee:PPP, 212Ha:CCC, 212Hf:CCC, 212Hi:CCC, 212J:CC, 212L:CC, 212Ra:CCC, 212Rc:CCC, 212Re:CCC, 212Sb:CCC, 212Sc:CCC, 212Sn:CCC, 212Sq:CCC, 212Te:CCC, 212Ya:CCC, 212Z:CC, 222Ib:CCP, 222Ie:CCC, 222Ud:CCC, 222Ue:CCC**CONCEPT****Associations:**

- *Thuja occidentalis* - (*Picea mariana*, *Abies balsamea*) / *Alnus incana* Forest (CEGL002456, G4)
- *Prunus pumila* - (*Ptelea trifoliata*) Dune Shrubland (CEGL005075, G2Q)

- *Chamaedaphne calyculata* - *Myrica gale* / *Carex lasiocarpa* Dwarf-shrubland (CEGL005228, G4G5)
- *Pinus banksiana* - (*Pinus resinosa*) - *Pinus strobus* / *Juniperus horizontalis* Wooded Herbaceous Vegetation (CEGL005125, G2)
- *Pinus banksiana* - *Pinus resinosa* - *Pinus strobus* Dune Forest (CEGL002589, G3Q)
- *Ammophila breviligulata* - (*Schizachyrium scoparium*) Herbaceous Vegetation (CEGL005098, G3G5)
- *Populus deltoides* - (*Juniperus virginiana*) Dune Woodland (CEGL005119, G1G2)
- *Juniperus horizontalis* - *Arctostaphylos uva-ursi* - *Juniperus communis* Dune Dwarf-shrubland (CEGL005064, G3G4)
- *Thuja occidentalis* - *Fraxinus nigra* Forest (CEGL005165, GNR)
- *Dasiphora fruticosa* ssp. *floribunda* / *Cladium mariscoides* - *Juncus balticus* - (*Rhynchospora capillacea*) Herbaceous Vegetation (CEGL005105, G3?)
- *Hudsonia tomentosa* Dune Dwarf-shrubland (CEGL004024, GNR)

High-ranked species: *Botrychium* sp. 3 (G3), *Brychius hungerfordi* (G1), *Charadrius melodus* (G3), *Copablepharon michiganensis* (G1G2), *Iris lacustris* (G3), *Lycopodiella margueritiae* (G1G2), *Lycopodiella subappressa* (G2), *Oligoneuron houghtonii* (G3), *Somatochlora hineana* (G2G3), *Trimerotropis huroniana* (G2G3)

Environment: The system consists of a foredune, followed by a series of low to high dunes (uplands) and swales (wetlands). The system is often best developed where post-glacial streams entered an embayment and provide a dependable sand source. The combination of along-shore currents, waves, and winds form foredunes along the shoreline. With gradual long-term drops in water level, combined with post-glacial uplifting of the earth's crust, these low dunes gradually rise above the direct influence of the lakes, and new foredunes replace them. Over several thousand years, a series of ridges and swales is created. For most complexes, the flow of surface streams and groundwater maintain the wet conditions in the swales. With time, plant succession has proceeded to the point where the beach ridges are now forested while the wet swales are either forested or open wetlands. Along the Lake Superior shoreline, where post-glacial uplift is greatest, many of the complexes consist primarily of dry, forested swales. The dunes and swales differs depending on fetch and the amount of sediment available. The influence of Great Lakes water-level fluctuations is probably limited to the first few swales inland from the shoreline. For most of the complexes, the water occupying the swales comes from streams flowing from the adjacent uplands or from groundwater seepage.

Vegetation: The foredunes of most dune-and-swale complexes are commonly 1-2 m high, with *Ammophila breviligulata*, *Calamovilfa longifolia*, *Salix serissima*, *Salix cordata*, and *Populus balsamifera* most common. The swale immediately behind the foredune is influenced by short-term variation in lake levels and can be partially or occasionally completely filled by dune sands following major storm events. Species common to this first swale include *Juncus balticus*, *Juncus pelocarpus*, *Juncus nodosus*, *Eleocharis acicularis*, and *Schoenoplectus americanus* (= *Scirpus americanus*). Occasionally, such swales may contain lake-influenced, calcareous sands, and the shallow swale may contain moderately alkaline indicators, such as *Cladium mariscoides*, *Myrica gale*, *Dasiphora fruticosa* ssp. *floribunda* (= *Pentaphylloides floribunda*), and others. A low dune field with more advanced plant succession often follows the first open dunes and swales. *Pinus banksiana*, *Pinus strobus*, and *Pinus resinosa* often form a scattered overstory canopy, while *Juniperus communis*, *Juniperus horizontalis*, *Arctostaphylos uva-ursi*, and *Koeleria macrantha* form a scattered ground layer. Following the dune-field zone, both dunes and swales are typically forested. Moist swales are often forested, and soil organic material has often begun to accumulate. *Thuja occidentalis*, *Alnus incana*, *Salix* spp., and *Acer rubrum* dominate the partial overstory canopy and understory. In contrast to the dry or moist swales, wetter swales (where standing water is present through most of the year) may be dominated by Carices, such as *Carex aquatilis* and *Carex stricta*. Forested beach ridges, with soils of medium to coarse sand, tend to be dominated by species common to dry-mesic and mesic northern forest. Soil moisture conditions appear to change dramatically with slight elevational changes and are reflected in the development of soil organic material and changing plant species. On higher, drier ridges, soils often have less than 3 cm of organic material. *Pinus resinosa*, *Pinus strobus*, and *Quercus rubra* are often codominant, while *Betula papyrifera*, *Populus grandidentata*, *Abies balsamea*, and *Acer rubrum* are subdominant or understory species. *Pteridium aquilinum*, *Gaylussacia baccata*, *Vaccinium myrtilloides*, *Cornus canadensis*, and *Gaultheria procumbens* occur in the shrub and ground layers. Complexes located in embayments protected from prevailing winds tend to be formed entirely of low, water-lain beach ridges. As a result, even the beach ridges within these complexes support wetland vegetation.

Dynamics: Foredune and immediate back dune areas are influenced by active dune processes of wind-caused "blowouts" and subsequent restabilization. Forested beach ridges may support fire regimes characteristic of similar upland forest systems outside of these complexes. Due to lakeshore proximity, heavy winds and resultant windthrow are common in forested ridges. Great Lakes water-level fluctuations likely influence water levels in swales closest to the shoreline, if at all. The hydrology of interdunal swales is driven largely by lateral flow through the porous beach ridges. Older swales (farthest from current lakeshores) in larger complexes support peat-forming bogs.

SOURCES

References: Comer and Albert 1993, Comer et al. 2003, Eyre 1980, Lichter 1998, MNFI 1999

Version: 11 Apr 2007

Concept Author: P. Comer and D. Albert

Stakeholders: Canada, East, Midwest

LeadResp: Midwest

CES201.575 LAURENTIAN-ACADIAN ALKALINE CONIFER-HARDWOOD SWAMP

Primary Division: Laurentian-Acadian (201)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland

Diagnostic Classifiers: Depressional; Thuja occidentalis - Fraxinus nigra; Mesotrophic Water; Circumneutral Water

National Mapping Codes: EVT 2481; ESLF 9345; ESP 1481

Concept Summary: These forested wetlands are found across northern New England and the upper Midwest and eastern to south-central Canada in basins where higher pH and/or nutrient levels are associated with a rich flora. The substrate is typically mineral soil, but there may be some peat; often, there is an organic epipedon over mineral soil. *Thuja occidentalis* is a diagnostic canopy species and may dominate the canopy or be mixed with other conifers or with deciduous trees, most commonly *Acer rubrum* or *Fraxinus nigra*. Some examples can be almost entirely deciduous and dominated by *Fraxinus nigra*. *Cornus sericea* is a common shrub. The herb layer tends to be more diverse than in acidic swamps. Small open fenny areas may occur within the wetland. Seepage may influence parts of the wetland, but the hydrology is dominated by the basin setting.

Comments: This system encompasses both wet forests (on saturated mineral soils) and forest rich peatlands. Areas dominated by *Fraxinus nigra* and found throughout the Laurentian area in Minnesota and north of Green Bay in Wisconsin are included in this system.

DISTRIBUTION

Range: Scattered locations from New England and adjacent Canada west to the Great Lakes and northern Minnesota.

Divisions: 201:C

TNC Ecoregions: 47:C, 48:C, 60:C, 61:C, 63:C, 64:C

Nations: US

Subnations: CT, ME, MI, MN, NY, VT, WI

Map Zones: 40:C, 41:C, 50:C, 51:C, 63:C, 64:C, 65:C, 66:C

USFS Ecomap Regions: 211Aa:CCC, 211Ab:CCC, 211Ba:CCC, 211Bb:CCC, 211Ca:CCC, 211Cb:CCP, 211Ea:CCC, 211Eb:CCP, 211Ec:CCC, 211Ed:CCC, 211Ee:CCC, 211Fb:CCC, 211Ja:CCP, 211Jb:CCP, 211Jc:CCP, 211Jd:CCC, 212Ha:CCC, 212Hb:CCC, 212Hc:CCC, 212Hd:CCC, 212He:CCC, 212Hf:CCC, 212Hg:CCC, 212Hh:CCC, 212Hi:CCC, 212Hj:CCC, 212Hk:CCC, 212Hl:CCC, 212Hm:CCC, 212Ra:CCC, 212Rb:CCC, 212Rc:CCC, 212Rd:CCC, 212Re:CCC, 222Ib:CCC, 222Ic:CCC, 222Id:CCP, 222Ie:CCC, 222Ja:CCC, 222Ue:CCC, M211Aa:CCP, M211Ab:CCC, M211Ac:CCP, M211Ad:CCP, M211Ae:CCC, M211Af:CCC, M211Ba:CCC, M211Bb:CCP, M211Ca:CCC, M211Cb:CCC, M211Da:CCC, M211Db:CCC, M211Dc:CCC, M211Dd:CCC, M211De:CCC

CONCEPT

Associations:

- *Thuja occidentalis* - (*Picea mariana*, *Abies balsamea*) / *Alnus incana* Forest (CEGL002456, G4)
- *Populus tremuloides* - *Populus balsamifera* - Mixed Hardwoods Lowland Forest (CEGL005036, G5)
- *Acer rubrum* - *Fraxinus* spp. - *Betula papyrifera* / *Cornus canadensis* Forest (CEGL002071, G4)
- *Thuja occidentalis* / *Sphagnum* (*girgensohnii*, *warnstorffii*) Forest (CEGL006007, GNR)
- *Fraxinus nigra* - Mixed Hardwoods - Conifers / *Cornus sericea* / *Carex* spp. Forest (CEGL002105, G4)
- *Larix laricina* / *Alnus incana* Forest (CEGL002471, G4)
- *Thuja occidentalis* - *Betula alleghaniensis* Forest (CEGL002450, G2Q)
- *Thuja occidentalis* - *Acer rubrum* / *Cornus sericea* Forest (CEGL006199, GNR)
- *Thuja occidentalis* - (*Larix laricina*) Seepage Forest (CEGL002455, G3G4)
- *Thuja occidentalis* - *Fraxinus nigra* Forest (CEGL005165, GNR)
- *Tsuga canadensis* - *Betula alleghaniensis* Saturated Forest (CEGL005003, G3)

High-ranked species: *Appalachia arcana* (G2G3), *Brychius hungerfordi* (G1), *Caloplaca parvula* (G1G2), *Clonophis kirtlandii* (G2), *Frullania selwyniana* (G2G3), *Isoetes hieroglyphica* (G1G2Q), *Lithophane thujae* (G3G4), *Mimulus glabratus* var. *michiganensis* (G5T1), *Poa paludigena* (G3), *Polemonium occidentale* ssp. *lacustre* (G5?T1Q), *Sarracenia purpurea* ssp. *heterophylla* (G5T1T2Q), *Somatochlora hineana* (G2G3), *Stenelmis douglasensis* (G1G3)

SOURCES

References: Comer and Albert 1997, Comer et al. 1995a, Comer et al. 1998, Comer et al. 2003, Eyre 1980, Gawler and Cutko 2010

Version: 14 Dec 2004

Stakeholders: Canada, East, Midwest

Concept Author: S.C. Gawler

LeadResp: East

CES202.605 NORTH-CENTRAL INTERIOR AND APPALACHIAN RICH SWAMP

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland

Diagnostic Classifiers: Temperate; Depressional; Broad-Leaved Deciduous Tree; Mesotrophic Water; Saturated Soil

Concept Summary: These forested wetlands are scattered throughout the north-central Midwest (south of the Laurentian region), the north-central Appalachians and southern New England at low to mid elevations. They are found in basins where higher pH and/or

nutrient levels are associated with a rich flora. Species include *Acer rubrum*, *Fraxinus nigra*, as well as calciphilic herbs. Conifers include *Larix laricina*, but typically not *Thuja occidentalis*, which is characteristic of more northern wetland systems. There may be shrubby or herbaceous openings within the primarily wooded cover. The substrate is primarily mineral soil, but there may be some peat development.

Comments: This system occurs south of the Laurentian-Acadian region, and these circumneutral or enriched swamps are often rather distinctive and discrete elements of the landscape. They are related to Laurentian-Acadian Alkaline Conifer-Hardwood Swamp (CES201.575) but have more temperate elements and generally lack *Thuja occidentalis*. More alkaline shrub/herb fens are treated as part of North-Central Interior Shrub-Graminoid Alkaline Fen (CES202.702).

DISTRIBUTION

Range: This system is found from central New England to the southern Great Lakes and south-central Minnesota south to northern Illinois, Indiana, Ohio, and Pennsylvania. It is not known to extend south into the Southern Blue Ridge.

Divisions: 202:C

TNC Ecoregions: 45:C, 46:C, 48:C, 49:P, 59:C, 60:?, 61:C

Nations: CA, US

Subnations: CT, DE?, IL, IN, MA, MD, MI, MN, NJ, NY, OH, ON, PA, RI, VT, WI

Map Zones: 41:C, 49:C, 50:C, 51:C, 52:C, 53:C, 61:C, 62:C, 63:C, 64:C, 65:C

USFS Ecomap Regions: 212Hb:CCP, 222H:CC, 222Ja:CCC, 222Jb:CCC, 222Jc:CCC, 222Je:CCC, 222Jg:CCC, 222Jh:CCC, 222Ji:CCC, 222K:CC, 222L:CC, 222M:CC, 222Ua:CCC, 222Ud:CCC, 222Ue:CCC, M211Cc:CCC

CONCEPT

Associations:

- *Acer rubrum* - *Fraxinus nigra* - (*Tsuga canadensis*) / *Tiarella cordifolia* Forest (CEGL006502, GNR)
- *Fraxinus nigra* - *Acer rubrum* / *Rhamnus alnifolia* / *Carex leptalea* Saturated Forest (CEGL007441, GNR)
- *Acer (rubrum, saccharinum)* - *Fraxinus* spp. - *Ulmus americana* Forest (CEGL005038, G4?)
- *Larix laricina* - *Acer rubrum* / (*Rhamnus alnifolia*, *Vaccinium corymbosum*) Forest (CEGL005232, G2G3)
- *Acer rubrum* - *Fraxinus americana* - *Fraxinus nigra* - *Betula alleghaniensis* / *Veratrum viride* - *Carex bromoides* Forest (CEGL008416, G3)
- *Acer rubrum* - *Fraxinus nigra* - (*Larix laricina*) / *Rhamnus alnifolia* Forest (CEGL006009, GNR)

High-ranked species: *Clonophis kirtlandii* (G2), *Euphyes dukesi* (G3), *Poa paludigena* (G3)

SOURCES

References: Comer et al. 2003, Eyre 1980, Fleming et al. 2005

Version: 05 May 2008

Concept Author: S.C. Gawler

Stakeholders: Canada, East, Midwest, Southeast

LeadResp: East

1.B.3.Nb. Southeastern North American Flooded & Swamp Forest

M031. SOUTHERN FLOODPLAIN HARDWOOD FOREST

G033. Bald-cypress - Tupelo Floodplain Forest

CES203.490 MISSISSIPPI RIVER BOTTOMLAND DEPRESSION

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland

Diagnostic Classifiers: Forest and Woodland (Treed); Riverine / Alluvial [Brownwater]; Needle-Leaved Tree; Broad-Leaved Deciduous Tree

Concept Summary: This system represents semipermanently flooded to saturated depressional areas of the lower Mississippi River Alluvial Valley, from southern Illinois south to Mississippi and Louisiana. These areas have a distinctly longer hydroperiod than other parts of the landscape. Typical and characteristic trees in examples of this system include *Acer rubrum* var. *drummondii*, *Carya aquatica*, *Fraxinus profunda*, *Gleditsia aquatica*, *Nyssa aquatica*, *Nyssa biflora*, *Planera aquatica*, *Quercus lyrata*, *Quercus palustris*, *Salix nigra*, and *Taxodium distichum*. Some characteristic shrubs include *Cephalanthus occidentalis*, *Cornus foemina*, *Decodon verticillatus*, *Forestiera acuminata*, *Itea virginica*, and *Planera aquatica*. Herbs are uncommon, but *Ludwigia peploides*, *Sagittaria lancifolia*, *Ceratophyllum* spp., *Elodea* spp., *Potamogeton* spp., and *Lemna minor* may be found.

DISTRIBUTION

Range: This system is found in the Mississippi Alluvial Plain from southern Illinois south to Mississippi and Louisiana.

Divisions: 203:C

TNC Ecoregions: 42:C

Nations: US

Subnations: AR, IL, KY, LA, MO, MS, TN

Map Zones: 45:C, 47:?, 98:C

USFS Ecomap Regions: 232E:CC, 234A:CC, 234C:CC, 234D:CC, 234E:CC

CONCEPT

Associations:

- *Quercus lyrata* - *Quercus palustris* / *Acer rubrum* var. *drummondii* / *Itea virginica* - *Cornus foemina* - (*Lindera melissifolia*) Forest (CEGL004778, G2?)
- *Taxodium distichum* / *Planera aquatica* - *Forestiera acuminata* Lakeshore Woodland (CEGL007909, GNR)
- *Potamogeton* spp. - *Ceratophyllum* spp. - *Elodea* spp. Permanently Flooded Herbaceous Vegetation (CEGL004725, G4?)
- *Taxodium distichum* - (*Nyssa aquatica*) / *Forestiera acuminata* - *Planera aquatica* Forest (CEGL002421, G3G5)
- *Taxodium distichum* / *Lemna minor* Forest (CEGL002420, G4G5)
- *Planera aquatica* Forest (CEGL007394, G4?)
- *Forestiera acuminata* - (*Planera aquatica*, *Cephalanthus occidentalis*) Shrubland (CEGL003911, G3?)
- *Gleditsia aquatica* - *Carya aquatica* Forest (CEGL007426, G3?)
- *Taxodium distichum* - *Nyssa aquatica* - *Acer rubrum* / *Itea virginica* Forest (CEGL007422, G4?)
- *Salix nigra* / *Sagittaria lancifolia* Forest (CEGL007436, G4?)
- *Nyssa aquatica* - *Nyssa biflora* Forest (CEGL007429, G4G5)
- *Nyssa aquatica* Forest (CEGL002419, G4G5)
- *Acer rubrum* - *Gleditsia aquatica* - *Planera aquatica* - *Fraxinus profunda* Forest (CEGL002422, G3G5)
- *Ludwigia peploides* Herbaceous Vegetation (CEGL007835, G4G5)
- *Salix nigra* / (*Clethra alnifolia*, *Morella cerifera*) / *Nyssa aquatica* Successional Forest (CEGL007411, GNA)
- *Cephalanthus occidentalis* / *Carex* spp. - *Lemna* spp. Southern Shrubland (CEGL002191, G4)
- *Nyssa aquatica* Floodplain Forest [Placeholder] (CEGL007389, GNR)
- *Decodon verticillatus* Seasonally Flooded Shrubland (CEGL003905, G4)
- *Salix nigra* / (*Cephalanthus occidentalis*) Forest (CEGL004773, G4G5)
- *Quercus lyrata* - *Carya aquatica* Forest (CEGL007397, G4G5)

Environment: Examples of this system are found in depressions and backswamps of the lower Mississippi River Alluvial Valley, from southern Illinois south to Mississippi and Louisiana. These areas have a distinctly longer hydroperiod than other parts of the landscape.

Vegetation: Typical and characteristic trees in examples of this system include *Acer rubrum* var. *drummondii*, *Carya aquatica*, *Fraxinus profunda*, *Gleditsia aquatica*, *Nyssa aquatica*, *Nyssa biflora*, *Planera aquatica*, *Quercus lyrata*, *Quercus palustris*, *Salix nigra*, and *Taxodium distichum*. Some characteristic shrubs include *Cephalanthus occidentalis*, *Cornus foemina*, *Decodon verticillatus*, *Forestiera acuminata*, *Itea virginica*, and *Planera aquatica*. Herbs are uncommon, but *Ludwigia peploides*, *Sagittaria lancifolia*, *Ceratophyllum* spp., *Elodea* spp., *Potamogeton* spp., and *Lemna minor* may be found.

SOURCES

References: Comer et al. 2003, Evans 1991, Eyre 1980

Version: 23 Jan 2008

Concept Author: T. Foti and R. Evans

Stakeholders: Midwest, Southeast

LeadResp: Southeast

CES203.195 MISSISSIPPI RIVER LOW FLOODPLAIN (BOTTOMLAND) FOREST

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Linear

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland

Diagnostic Classifiers: Riverine / Alluvial [Brownwater]

Concept Summary: "Low bottomlands" are usually seasonally flooded in backswamps, with flooding more frequent than every five years, usually more frequently than every two years, generally by still water that may be impounded behind natural levees, and are classed as Low Gradient Riverine Backwater wetlands in hydrogeomorphic classifications. Low bottomlands occur along the Mississippi River and its tributaries in the Mississippi River Alluvial Plain ecoregion. Prolonged flooding dominates this system, and its duration is greater than in the adjacent Mississippi River Riparian Forest. Overcup oak is the characteristic dominant species. Soils are clayey with poor internal drainage.

DISTRIBUTION

Range: This system is found in the Mississippi Alluvial Plain from southern Illinois south to Mississippi and Louisiana.

Divisions: 203:C

TNC Ecoregions: 42:C

Nations: US

Subnations: AR, IL, KY, LA, MO, MS, TN

Map Zones: 45:C, 47:C, 98:C

USFS Ecomap Regions: 232E:CC, 234A:CC, 234C:CC, 234D:CC, 234E:CC

CONCEPT

Associations:

- *Quercus lyrata* - *Liquidambar styraciflua* / *Forestiera acuminata* Forest (CEGL002424, G4?)
- *Quercus lyrata* - *Carya aquatica* - (*Quercus texana*) / *Forestiera acuminata* Forest (CEGL002423, G3?)
- *Quercus texana* - *Quercus lyrata* Forest (CEGL007407, G3G4)

Environment: "Low bottomlands" are usually seasonally flooded in backswamps, with flooding more frequent than every five years, usually more frequently than every two years, generally by still water that may be impounded behind natural levees, and are classed as Low Gradient Riverine Backwater wetlands in hydrogeomorphic classifications (Klimas et al. 2004).

Dynamics: Changes in soils and vegetation of this system are much slower than in the adjacent Mississippi River Riparian Forest. Regeneration is through small treefall gaps or large tornado tracks.

SOURCES

References: Evans 1991, Eyre 1980, Klimas et al. 1981, Southeastern Ecology Working Group n.d.

Version: 17 Feb 2005

Concept Author: T. Foti, M. Pyne

Stakeholders: Midwest, Southeast

LeadResp: Southeast

G034. Oak - Sweetgum Floodplain Forest

CES203.554 EAST GULF COASTAL PLAIN NORTHERN SEEPAGE SWAMP

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland

Diagnostic Classifiers: Seepage-Fed Sloping

Concept Summary: This wetland system of the Upper East Gulf Coastal Plain consists of forested wetlands in acidic, seepage-influenced habitats. These are mostly deciduous forests (and less commonly herbaceous communities) generally found at the base of slopes or other habitats where seepage flow is concentrated. Resulting moisture conditions are saturated or even inundated. The vegetation is characterized by *Nyssa sylvatica*, *Nyssa biflora*, and *Acer rubrum*. Examples occur in portions of the Coastal Plain north of the range of *Persea palustris* and *Magnolia grandiflora*. *Magnolia virginiana* is of less value as a differential species. To the south this system grades into Southern Coastal Plain Seepage Swamp and Baygall (CES203.505), where evergreen species are of much greater importance in the canopy and understory. Due to excessive wetness, these habitats are normally protected from fire except those which occur during extreme droughty periods. These environments are prone to long-duration standing water and tend to occur on highly acidic, nutrient-poor soils.

Comments: Some authors have treated *Persea palustris* (of wetlands) and *Persea borbonia* (of uplands) as one taxon under a broadly conceived *Persea borbonia*. We recognize two distinct taxa, following Kartesz (1999) and Weakley (2005).

DISTRIBUTION

Range: This system is found in the East Gulf Coastal Plain portions of western Kentucky (Funk 1975) and Tennessee, northern Mississippi, northwestern and central Alabama, and southern Illinois.

Divisions: 203:C

TNC Ecoregions: 43:C

Nations: US

Subnations: AL, IL, KY, MS, TN

Map Zones: 46:C, 47:C, 49:?

USFS Ecomap Regions: 231B:CC, 231H:CC

CONCEPT

Associations:

- *Acer rubrum* var. *trilobum* - *Nyssa sylvatica* / *Rhododendron canescens* - *Viburnum nudum* var. *nudum* / *Woodwardia areolata* Forest (CEGL004425, G2G3)
- *Carex crinita* - *Osmunda* spp. / *Sphagnum* spp. Herbaceous Vegetation (CEGL002263, G2G3)
- *Magnolia virginiana* - *Nyssa biflora* / *Oxydendrum arboreum* / *Viburnum nudum* var. *nudum* Forest (CEGL008552, G3?)
- *Nyssa biflora* - *Liquidambar styraciflua* / *Magnolia virginiana* / *Hamamelis virginiana* - *Viburnum nudum* Forest (CEGL008477, G2G3)

High-ranked species: *Hexastylis speciosa* (G2), *Pinguicula primuliflora* (G3G4)

Vegetation: The vegetation is characterized by *Nyssa sylvatica*, *Nyssa biflora*, and *Acer rubrum*. The canopies of stands are primarily deciduous-dominated. Stands in the southern part of the system's range may contain *Magnolia virginiana*, particularly in the

understory. This system occurs north of the range of *Persea palustris* and *Magnolia grandiflora*, and these species will be lacking from stands.

Dynamics: Due to excessive wetness, these habitats are normally protected from fire except those which occur during extreme droughty periods. These environments are prone to long-duration standing water and tend to occur on highly acidic, nutrient-poor soils.

SOURCES

References: Comer et al. 2003, Eyre 1980, Funk 1975, Kartesz 1999, Weakley 2005

Version: 27 Sep 2005

Concept Author: R. Evans and M. Pyne

Stakeholders: Midwest, Southeast

LeadResp: Southeast

CES203.189 LOWER MISSISSIPPI RIVER DUNE POND

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Forest and Woodland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland

Diagnostic Classifiers: Forest and Woodland (Treed); Dune (Substrate); Sand Soil Texture

Concept Summary: This system represents distinctive wetlands that are called "sand ponds" in Arkansas. They occur in isolated depressions in the context of sand dunes and related eolian features of the lower Mississippi River Alluvial Valley in Missouri and Arkansas. These depressions have silty bottoms and may be connected to the local aquifer or have a perched water table. The margins of these ponds are rimmed by *Quercus phellos* and also have *Quercus lyrata*. These Pleistocene dunes were overlooked or unrecognized until the late 1970s (Saucier 1978). These dunes are west of Crowley's Ridge and near the Black and White rivers, above the normal flood level of the Mississippi. Examples in Missouri occur amidst a series of low-lying, anastomosing channels that have helped to protect them from extensive alteration more typical in Arkansas where the uplands have been largely cleared.

Comments: These depressions in the dune fields are one of the principal habitats for the rare shrub *Lindera melissifolia* (Heineke 1987). The dunes consist of a layer of sand or sandy loam over an impervious sublayer. This large area of eolian sand dunes occurs "mainly in a long band to the west of Crowley's Ridge" and occupies approximately 1000 square kilometers (400 square miles) in discrete fields of up to 78 square kilometers (30 square miles) each (Heineke 1987).

Quercus lyrata - *Quercus palustris* / *Acer rubrum* var. *drummondii* / *Itea virginica* - *Cornus foemina* - (*Lindera melissifolia*) Forest (CEGL004778), a wetland type, occurs in isolated depressions in the dunes that may be connected to the local aquifer or have a perched water table (T. Foti pers. comm.).

DISTRIBUTION

Range: This system is found in the Lower Mississippi River Alluvial Valley in Missouri (Ripley County, Sand Ponds Natural Area) and Arkansas. In Arkansas, examples occur in Clay, Jackson, Lawrence, and Woodruff counties.

Divisions: 202:?, 203:C

TNC Ecoregions: 42:C

Nations: US

Subnations: AR, MO

Map Zones: 45:C

CONCEPT

Associations:

- *Quercus lyrata* - *Quercus palustris* / *Acer rubrum* var. *drummondii* / *Itea virginica* - *Cornus foemina* - (*Lindera melissifolia*) Forest (CEGL004778, G2?)

High-ranked species: *Lindera melissifolia* (G2G3)

Environment: This system occurs in isolated depressions in the context of sand dunes and related eolian features of the lower Mississippi River Alluvial Valley in Missouri and Arkansas. These depressions have silty bottoms and may be connected to the local aquifer or have a perched water table (T. Foti pers. comm.). These dunes are west of Crowley's Ridge and near the Black and White rivers, above the normal flood level of the Mississippi. Examples in Missouri occur amidst a series of low-lying, anastomosing channels that have helped to protect them from extensive alteration more typical in Arkansas where the uplands have been largely cleared.

Vegetation: The margins of these ponds are rimmed by *Quercus phellos* and also have *Quercus lyrata* (Heineke 1987).

SOURCES

References: Eyre 1980, Foti pers. comm., Heineke 1987, Saucier 1978, Southeastern Ecology Working Group n.d.

Version: 27 Jan 2005

Concept Author: T. Foti and M. Pyne

Stakeholders: Midwest, Southeast

LeadResp: Southeast

CES203.196 MISSISSIPPI RIVER HIGH FLOODPLAIN (BOTTOMLAND) FOREST**Primary Division:** Gulf and Atlantic Coastal Plain (203)**Land Cover Class:** Woody Wetland**Spatial Scale & Pattern:** Linear**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Wetland**Diagnostic Classifiers:** Riverine / Alluvial [Brownwater]

Concept Summary: "High bottomlands" are often temporarily flooded on older Holocene point bars and natural levees, with flooding less frequent than every five years. Wetland functions are primarily driven by precipitation and are classed as floodplain flats in a hydrogeomorphic classification (Klimas et al. 2004). They are flooded less frequently than adjacent riparian floodplains or low floodplains. These floodplains are of particular conservation interest because they have been cleared to a greater extent than riparian or low floodplains because of the reduced flooding of these sites. Also, flood control levees protect many of these sites, and with protection from levees, almost all sites are cleared. Thus, most wetlands remaining in large bottomland areas are riparian or low bottomlands, and the species, communities and other characteristics of high bottomlands have been essentially lost. Wildlife agency partners generally would like to see this distinction recognized. Because many of these sites are adjacent to uplands or non-flooded hydroxic flatwoods, both of which have a relatively high fire frequency, and high floodplains are relatively dry, they have a much higher typical fire frequency than lower bottomlands. Therefore, under pre-development conditions, they would have been more open and had a higher ground layer diversity than other floodplain systems.

DISTRIBUTION**Range:** This system is found in the Mississippi Alluvial Plain from southern Illinois south to Mississippi and Louisiana.**Divisions:** 203:C**TNC Ecoregions:** 42:C**Nations:** US**Subnations:** AR, IL, KY, LA, MO, MS, TN**Map Zones:** 45:C, 47:C, 98:C**USFS Ecomap Regions:** 232E:CC, 234A:CC, 234C:CC, 234D:CC, 234E:CC**CONCEPT****Associations:**

- *Quercus texana* - *Celtis laevigata* - *Ulmus (americana, crassifolia)* - (*Gleditsia triacanthos*) Forest (CEGL004619, G4G5)
- *Quercus phellos* - *Quercus nigra* - *Liquidambar styraciflua* Mississippi River Alluvial Plain Forest (CEGL007915, G4G5)
- *Vitis rotundifolia* - *Ampelopsis arborea* - *Campsis radicans* Vine-Shrubland (CEGL004620, GNA)
- *Quercus palustris* - (*Quercus stellata*) - *Quercus pagoda* / *Isoetes* spp. Forest (CEGL002101, G2G3)
- *Quercus phellos* - (*Quercus lyrata*) / *Carex* spp. - *Leersia* spp. Forest (CEGL002102, G3G4Q)
- *Fraxinus pennsylvanica* - *Ulmus americana* - *Celtis laevigata* / *Ilex decidua* Forest (CEGL002427, G4G5)
- *Quercus virginiana* - *Quercus pagoda* - *Magnolia grandiflora* / *Cornus florida* / *Sanicula* sp. Forest (CEGL007469, G2G3)
- *Quercus virginiana* - *Quercus nigra* - *Liquidambar styraciflua* / *Ilex opaca* var. *opaca* / *Viburnum dentatum* Forest (CEGL007476, G2G3)
- *Arundinaria gigantea* ssp. *gigantea* Shrubland (CEGL003836, G2?)
- *Quercus phellos* - (*Quercus similis*) - *Ulmus crassifolia* Forest (CEGL007921, G3G4)
- *Quercus laurifolia* - *Quercus nigra* Mississippi River Alluvial Plain Forest (CEGL007916, GNR)
- *Quercus virginiana* - *Celtis laevigata* - *Quercus pagoda* / *Sabal minor* Forest (CEGL004648, G2)
- *Quercus michauxii* - *Quercus shumardii* - *Liquidambar styraciflua* / *Arundinaria gigantea* Forest (CEGL002099, G3G4)
- *Fraxinus pennsylvanica* - *Populus heterophylla* - *Ulmus americana* - (*Quercus texana*) Forest (CEGL004694, G2?)

Environment: These "high bottomlands" are often temporarily flooded on older Holocene point bars and natural levees, with flooding less frequent than every five years. Wetland functions are primarily driven by precipitation and are classed as floodplain flats in a hydrogeomorphic classification (Klimas et al. 2004). They are flooded less frequently than adjacent riparian floodplains or low floodplains.

Vegetation: Typical dominant trees in stands of this system include *Liquidambar styraciflua*, *Quercus laurifolia*, *Quercus michauxii*, *Quercus nigra*, *Quercus pagoda*, *Quercus phellos*, *Quercus shumardii*, *Quercus texana*, and *Carya* spp. Southern examples may contain *Quercus virginiana* and/or *Magnolia grandiflora*, northern ones may contain *Quercus palustris*. Wetter inclusions may contain *Quercus lyrata*. Some stands which lack these species may exhibit dominance by *Fraxinus pennsylvanica*, *Ulmus americana*, and *Celtis laevigata*. *Gleditsia triacanthos* may also be a component. *Ulmus crassifolia* may be more commonly found west of the Mississippi River. Some small trees and shrubs include *Cornus florida*, *Ilex decidua*, *Ilex opaca* var. *opaca*, *Viburnum dentatum*, and *Carpinus caroliniana*. Southern stands may contain *Sabal minor*. The perennial graminoid bamboo *Arundinaria gigantea* ssp. *gigantea* may dominate the shrub stratum of some forests, or it may form non-forested stands called "canebrakes". *Vitis rotundifolia*, *Ampelopsis arborea*, and *Campsis radicans* are common vines.

Dynamics: Regeneration of remaining examples today are typified by small gap regeneration or large patch regeneration in tornado tracks, but originally, fire may have opened larger patches in which regeneration occurred.

SOURCES**References:** Evans 1991, Eyre 1980, Southeastern Ecology Working Group n.d.**Version:** 18 Apr 2005**Concept Author:** T. Foti and M. Pyne**Stakeholders:** Midwest, Southeast**LeadResp:** Southeast**CES203.190 MISSISSIPPI RIVER RIPARIAN FOREST****Primary Division:** Gulf and Atlantic Coastal Plain (203)**Land Cover Class:** Woody Wetland**Spatial Scale & Pattern:** Linear**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Wetland**Diagnostic Classifiers:** Riverine / Alluvial [Brownwater]

Concept Summary: This ecological system consists of riverfront vegetation, which is generally temporarily (but rarely seasonally) flooded, on point bars and natural levees adjacent to the river that formed them. The period between floods is less than five years, and the flooding is caused by water flowing directly from the channel. Examples occur along the lower Mississippi River and its tributaries in the Mississippi River Alluvial Plain ecoregion. They are classed as Low Gradient Riverine Overbank wetlands in a hydrogeomorphic classification. The flooding is of shorter duration than on adjacent backswamps where water is impounded behind riverfront natural levees, and is of longer duration than on adjacent high bottomlands that are typically temporarily flooded. Soils are typically sandier than those of low bottomlands. Giant cane is a common understory component in these forests on natural levees and higher point bars, and may become dominant after thinning or removal of the overstory. Willow and cottonwood sandbars may have an open-canopy (woodland) structure.

DISTRIBUTION**Range:** This system is found in the Mississippi Alluvial Plain from southern Illinois south to Mississippi and Louisiana.**Divisions:** 203:C**TNC Ecoregions:** 42:C**Nations:** US**Subnations:** AR, IL, KY, LA, MO, MS, TN**Map Zones:** 45:C, 47:C, 98:C**USFS Ecomap Regions:** 232E:CC, 234A:CC, 234C:CC, 234D:CC, 234E:CC**CONCEPT****Associations:**

- *Quercus texana* - *Celtis laevigata* - *Ulmus (americana, crassifolia)* - (*Gleditsia triacanthos*) Forest (CEGL004619, G4G5)
- *Acer negundo* Forest (CEGL005033, G4G5)
- *Populus deltoides* - *Salix nigra* / *Mikania scandens* Forest (CEGL007346, G4G5)
- *Platanus occidentalis* - *Fraxinus pennsylvanica* - *Celtis laevigata* - (*Liquidambar styraciflua*) Forest (CEGL007913, G4)
- *Fraxinus pennsylvanica* - *Ulmus americana* - *Celtis laevigata* / *Ilex decidua* Forest (CEGL002427, G4G5)
- *Quercus virginiana* - *Quercus pagoda* - *Magnolia grandiflora* / *Cornus florida* / *Sanicula* sp. Forest (CEGL007469, G2G3)
- *Acer saccharinum* - *Ulmus americana* Forest (CEGL002586, G4?)
- *Acer saccharinum* - *Celtis laevigata* - *Carya illinoensis* Forest (CEGL002431, G3G4)
- *Quercus virginiana* - *Quercus nigra* - *Liquidambar styraciflua* / *Ilex opaca* var. *opaca* / *Viburnum dentatum* Forest (CEGL007476, G2G3)
- *Carya illinoensis* - *Celtis laevigata* - *Ulmus (americana, crassifolia)* Mississippi River Alluvial Plain Forest (CEGL007912, G2G3)
- *Arundinaria gigantea* ssp. *gigantea* Shrubland (CEGL003836, G2?)
- *Quercus laurifolia* - *Quercus nigra* Mississippi River Alluvial Plain Forest (CEGL007916, GNR)
- *Populus deltoides* - *Salix nigra* Forest (CEGL002018, G3G4)
- *Salix nigra* / (*Clethra alnifolia*, *Morella cerifera*) / *Nyssa aquatica* Successional Forest (CEGL007411, GNA)
- *Quercus virginiana* - *Celtis laevigata* - *Quercus pagoda* / *Sabal minor* Forest (CEGL004648, G2)

Environment: Stands of this system are generally temporarily (but rarely seasonally) flooded on point bars and natural levees adjacent to the river that formed them, with flooding more frequent than every five years, by flowing water directly from the stream. They are classed as Low Gradient Riverine Overbank wetlands in a hydrogeomorphic classification (Klimas et al. 2004). Flooding is of lower duration than on adjacent backswamps where water is impounded behind riverfront natural levees. Flooding is of longer duration than on adjacent high bottomlands that are typically temporarily flooded. Soils are typically sandier than those of low bottomlands.

Vegetation: Some of the most typical and characteristic tree species found in stands of this system include *Acer negundo*, *Acer saccharinum*, *Platanus occidentalis*, *Populus deltoides*, and *Salix nigra*. Other trees may include *Celtis laevigata*, *Carya illinoensis*, *Fraxinus pennsylvanica*, *Gleditsia triacanthos*, *Liquidambar styraciflua*, *Quercus nigra*, *Quercus pagoda*, *Quercus texana*, *Ulmus americana*, and *Ulmus crassifolia*. In addition, *Quercus virginiana* may be present within its range. *Arundinaria gigantea* ssp.

gigantea is a common understory component in these forests on natural levees and higher point bars, and may become dominant after thinning or removal of the overstory.

Dynamics: Often on sites with rapid soil deposition and, therefore, with rapid development of vegetation from low-diversity willow- and cottonwood-dominated communities to more diverse communities dominated by sycamore, pecan, sugarberry, green ash or Nuttall oak. Regeneration is through small treefall gaps or large tornado tracks.

SOURCES

References: Evans 1991, Eyre 1980, Klimas et al. 1981, Southeastern Ecology Working Group n.d.

Version: 17 Mar 2009

Stakeholders: Midwest, Southeast

Concept Author: T. Foti, M. Pyne

LeadResp: Southeast

M033. SOUTHERN COASTAL PLAIN BASIN SWAMP

G130. Loblolly Pine & Hardwood Wet Flatwoods

CES203.193 LOWER MISSISSIPPI RIVER FLATWOODS

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland

National Mapping Codes: EVT 2513; ESLF 9191; ESP 1513

Concept Summary: This system is comprised of forests, prairies and woodlands on Pleistocene terraces in the Mississippi Alluvial Plain of Arkansas, Missouri and Louisiana. It occurs primarily west of Crowley's Ridge on Pleistocene glacial outwash deposits in Arkansas and Missouri, and on Macon Ridge in Louisiana and adjacent Arkansas. The sites are above modern floodplains, but have poor internal drainage and are flat with poor runoff, leading to very wet conditions in winter and spring. They also often have a claypan that restricts both internal drainage and, later in the year, water availability. Therefore, they are very wet in the winter/spring and very dry in the summer, a moisture regime termed hydroxic. Because of this moisture regime, the communities are variable, ranging from willow oak flats to post oak flats to prairies. In the 1940s, the Arkansas Game and Fish Commission produced a wildlife habitat map of Arkansas in which these sites were classified as "terrace hardwood forests". These communities have a large variety of upland and lowland tree species, ranging from post oak to overcup oak in a small area. Such species diversity may be explained by regeneration of species with dramatically different moisture tolerances on the same site in dry and wet years on these hydroxic sites. Because the sites are above current floodplains and susceptible to being drained, they have been cleared at an even greater rate than nearby floodplain forests.

Comments: T. Foti (pers. comm. 2007): "I think it does encompass the Louisiana Mesic Hardwood Flatwoods, and the species listed in that description look good for the whole system. Do we want to leave the potential for prairies in this system or include them in the Grand Prairie system? I am inclined to think that small prairie inclusions should remain in this system and larger, individually definable prairies, such as those formerly across the White River from the Grand Prairie proper, could be included in that system. That distinction might be mentioned in the description. The Grand Prairie should be listed as a similar ecological system."

DISTRIBUTION

Range: This system is found in the Mississippi Alluvial Plain from the Missouri "bootheel" south to Louisiana. In Louisiana it is found on Macon Ridge (Ecoregion 73j (EPA 2004)). It is not reported from Kentucky, Tennessee, or Mississippi.

Divisions: 203:C

TNC Ecoregions: 42:C

Nations: US

Subnations: AR, LA, MO

Map Zones: 45:C, 98:P

USFS Ecomap Regions: 234A:CC, 234D:CC

CONCEPT

Associations:

Environment: The sites where this system is found are above modern floodplains, but have poor internal drainage and are flat with poor runoff, leading to very wet conditions in winter and spring. They also often have a claypan that restricts both internal drainage and, later in the year, water availability. Therefore, they are very wet in the winter/spring and very dry in the summer, a moisture regime termed hydroxic. In Louisiana, distinct mesic and wet community variants are recognized (LNHP 2004).

Vegetation: The communities of this system are variable, ranging from willow oak flats to post oak flats to prairies. In examples on Macon Ridge (Louisiana), overstory dominants include *Carya alba*, *Nyssa sylvatica*, *Quercus alba*, *Quercus pagoda*, *Quercus nigra*, *Quercus michauxii*, and *Liquidambar styraciflua*. In addition, *Quercus shumardii* and *Quercus falcata* are fairly frequent but not usually abundant. Common midstory trees include *Cornus florida*, *Ostrya virginiana*, *Aralia spinosa*, *Ulmus alata*, *Sassafras albidum*, and *Acer rubrum*. Important shrubs/small trees are *Vaccinium arboreum*, *Vaccinium virgatum*, *Viburnum rufidulum*, *Crataegus*

marshallii, *Aesculus pavia*, *Frangula caroliniana*, *Asimina triloba*, *Hypericum hypericoides*, and *Euonymus americanus*. Although infrequent, *Hamamelis virginiana* can be locally abundant. Important woody vines include *Toxicodendron radicans*, *Parthenocissus quinquefolia*, *Vitis rotundifolia*, *Vitis aestivalis*, and *Smilax smallii*. *Toxicodendron radicans* and *Parthenocissus quinquefolia* are usually thick on the ground, as well as being represented by high climbing individuals. Common and characteristic herbaceous plants include *Chasmanthium sessiliflorum*, *Dichanthelium boscii*, *Podophyllum peltatum*, *Carex cherokeensis*, *Elephantopus carolinianus*, *Elephantopus tomentosus*, *Scleria oligantha*, *Aristolochia serpentaria*, *Botrychium virginianum*, *Passiflora lutea*, *Dioscorea villosa*, *Clitoria mariana*, *Sanicula canadensis*, *Geum canadense*, *Galium circaezans*, *Agrimonia rostellata*, *Spigelia marilandica*, *Clematis virginiana*, *Phryma leptostachya*, *Ruellia caroliniensis*, and *Smallanthus uvedalius* (LNHP 2004).

SOURCES

References: EPA 2004, Foti pers. comm., LNHP 2004, Southeastern Ecology Working Group n.d.

Version: 30 Jan 2006

Concept Author: T. Foti and M. Pyne

Stakeholders: Midwest, Southeast

LeadResp: Southeast

1.B.4. BOREAL FOREST

1.B.4.Na. North American Boreal Forest

M495. EASTERN NORTH AMERICAN BOREAL FOREST

G047. Eastern Hemi-Boreal Dry-Mesic Pine - Black Spruce - Hardwood Forest

CES103.425 EASTERN HEMI-BOREAL DRY-MESIC PINE-BLACK SPRUCE-HARDWOOD FOREST

Primary Division: Boreal (103)

Land Cover Class: Forest and Woodland

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Concept Summary: This hemi-boreal forest ecological system is found on dry-mesic nutrient-poor soils in a variety of topographic settings. It ranges from northwestern Ontario to eastern Canada, and southward into Minnesota, the Great Lakes region, and very locally into northwestern Maine. Soils are loamy to sandy, varying from nutrient-poor, thin soils over bedrock to deeper soils, sometimes sandy. Sites are typically dry-mesic. The dominant fire regime varies from 50-100 years. *Pinus banksiana*, *Pinus resinosa*, and *Picea mariana* are characteristic overstory species, with *Pinus strobus* occasionally common, over much of the range, but east of the Great Lakes, *Picea mariana* becomes increasingly dominant with *Abies balsamea* as an important associate. Canopy structure is mostly closed but can be partially open. Conifers typically dominate the canopy, but boreal hardwoods (*Populus tremuloides*, *Betula papyrifera*) may codominate. As time since fire increases, *Picea mariana* may dominate. Tree regeneration includes *Abies balsamea*, *Betula papyrifera*, *Populus tremuloides*, and *Picea mariana*. The shrub and field layers can be very open to somewhat dense (5-75% cover). Characteristic low-shrub and herb species include *Amelanchier* spp., *Vaccinium angustifolium*, *Diervilla lonicera*, *Cornus canadensis*, *Linnaea borealis*, *Doellingeria umbellata* (= *Aster umbellatus*), and *Eurybia macrophylla*. Older *Picea mariana* stands may be strongly dominated by feathermosses.

Comments: In Quebec (C. Morneau pers. comm. 2009), *Picea mariana* is far more common than *Pinus banksiana* in the boreal forest. Secondly, forests composed of a mixture of *Picea mariana* and *Abies balsamea* with a feathermoss carpet on the ground are very common east of 74 degrees W longitude and north of 48 degrees N latitude where climate undergoes a maritime influence and where *Pinus banksiana* gradually becomes absent. *Picea mariana* - *Picea rubens* / *Rhododendron canadense* / *Cladina* spp. Woodland (CEGL006421), in the present system, represents spruce-lichen woodlands at the boreal-temperate forest interface.

At this time, this system excludes xeric *Pinus banksiana* and *Picea mariana* stands, which are placed in their own system, Eastern Hemi-Boreal Dry Jack Pine - Red Pine - Hardwood Woodland (CES103.424), found on dry, poor sites, where there is a low density of *Pinus banksiana* trees resulting in a woodland condition. Lichens are dominant. Woodland physiognomy and lichen dominance distinguish that system from this system, which has more of a closed canopy and feathermosses and herbs are more abundant. See also Minnesota DNR (2003), which separates Northern Dry-Sand Pine Woodland (FDn12) and Northern Dry-Bedrock Pine-(Oak) Woodland (FDn22), and belong with CES103.424, from the dry-mesic *Pinus banksiana* and *Picea mariana* Forests and Woodlands (FDn32 and FDn33), which belong with this system.

Placement of *Populus tremuloides* - (*Populus grandidentata*) Rocky Woodland (CEGL002487) in this system needs review.

DISTRIBUTION

Range: This system ranges from northwestern Ontario to eastern Canada, and southward into Minnesota, the Great Lakes region, and very locally into northwestern Maine.

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

Nations: CA, US

Subnations: LB, MB?, MI, MN, NB, NF, ON, QC, WI

CONCEPT

Associations:

Environment: Soils are loamy to sandy, varying from nutrient-poor, thin soil over bedrock to deeper soils, sometimes sandy. Sites are typically on dry-mesic to dry sites, but not commonly found on xeric sandplains or bedrock sites.

Vegetation: *Pinus banksiana* and *Picea mariana* are characteristic overstory species. In the Upper Great Lakes region, *Pinus banksiana* may intermix with *Pinus resinosa*. Canopy structure is mostly closed but can be partially open. Conifers typically dominate the canopy, but boreal hardwoods (*Populus tremuloides*, *Betula papyrifera*) may codominate. As time since fire increases, *Picea mariana* may dominate. Tree regeneration includes *Abies balsamea*, *Betula papyrifera*, *Populus tremuloides*, and *Picea mariana*. Characteristic low-shrub and herb species include *Amelanchier* spp., *Vaccinium angustifolium*, *Diervilla lonicera*, *Cornus canadensis*, *Linnaea borealis*, *Doellingeria umbellata* (= *Aster umbellatus*), and *Eurybia macrophylla*. Older *Picea mariana* stands may be strongly dominated by feathermosses (Minnesota DNR 2003).

SOURCES

References: Comer et al. 2003, Eyre 1980, Faber-Langendoen et al. 2013, Heinselman 1973, Minnesota DNR 2003, NatureServe n.d.

Version: 05 Sep 2012

Stakeholders: Canada, East, Midwest

Concept Author: K.A. Schulz, in Faber-Langendoen et al. (2012)

LeadResp: Midwest

G048. Eastern Hemi-Boreal Mesic Balsam Fir - Spruce - Hardwood Forest

CE103.020 EASTERN HEMI-BOREAL ASPEN-BIRCH FOREST

Primary Division: Boreal (103)

Land Cover Class: Forest and Woodland

Spatial Scale & Pattern: Matrix

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Forest and Woodland (Treed); Boreal [Boreal Continental]; Intermediate Disturbance Interval

National Mapping Codes: EVT 2301; ESLF 4107; ESP 1301

Concept Summary: These early-successional boreal hardwood forests and woodlands are widespread throughout the eastern hemi-boreal region of Canada, extending into parts of the Laurentian-Acadian region, but more localized eastward. They originate naturally after fires and blowdowns, but more commonly originate after logging of conifer or mixed conifer-hardwood systems. *Populus tremuloides* and *Betula papyrifera* are the most important tree species. This system is maintained by repeated disturbance within 50-year return intervals and would otherwise succeed to conifer systems. Localized stands of mixed conifer-hardwoods (pines and spruces) can occur in this type, but are more typically part of conifer systems.

Comments: As defined here, these are deciduous forest-dominated systems; mixed conifer-hardwoods areas will go in the appropriate conifer forest system. In addition, this system is primarily eastern hemi-boreal, because some northern hardwood species do occur; in the Laurentian-Acadian region, successional aspen-birch or red maple stands would be placed within the appropriate mature Laurentian-Acadian forest system (e.g., aspen-birch stands in Maine are placed within Acadian Low-Elevation Spruce-Fir-Hardwood Forest (CES201.565)). The perspective here is that *Picea rubens* (red spruce) is not a boreal species; stands of *Picea rubens* often contain many typical northern hardwood associates, rather than *Populus tremuloides* or *Betula papyrifera*. It is not clear how naturally this system occurs in the upper Midwest given catastrophic fires in the 1800s-early 1900s; is the extensive aspen-birch found in northern Minnesota this system or should those be considered part of northern hardwoods or spruce-fir? A workable approach for now would be to restrict this system to northernmost Minnesota and southern Lake Superior [see USFS Ecomap Regions].

The original "Boreal Aspen-Birch Forest" system was not well defined in Canada. As described it only covered the hemi-boreal region of eastern Canada. It has been renamed to reflect that concept. This system is closely related to Eastern Hemi-Boreal Mesic Balsam Fir-Spruce Forest (CES103.426), and within the IVC these are part of Eastern Hemi-Boreal Mesic Balsam Fir - Spruce - Hardwood Forest Group (G048). It may be that a series of aspen-birch systems separate from the spruce-fir systems, are needed for Eastern Boreal, Central Hemi-Boreal, Central Boreal, Western Boreal and Western Hemi-Boreal regions of the North American Boreal Forest. Or, conversely, this system (CES103.020) could be lumped within Eastern Hemi-Boreal Mesic Balsam Fir-Spruce Forest (CES103.426), and the distinction treated here and elsewhere at the alliance level, below system.

DISTRIBUTION

Range: This system is found in the hemi-boreal region of the Upper Great Lakes and southeastern Canada from northwestern Ontario and northern Minnesota east to Quebec (and possibly northern portions of the Canadian Maritimes).

Divisions: 103:C, 201:C

TNC Ecoregions: 47:C, 48:C

Nations: CA, US

Subnations: LB, MI, MN, NB?, NF, ON, QC, WI

Map Zones: 41:C, 50:C, 51:C

USFS Ecomap Regions: 212Ha:CPP, 212Hf:CPP, 212Hi:CPP, 212J:CP, 212Lb:CCC, 212M:CC, 212R:CP, 212S:CP, 212T:CP, 212X:CP, 212Y:CP

CONCEPT

Associations:

- *Populus tremuloides* - *Betula papyrifera* - (*Acer rubrum*, *Populus grandidentata*) Forest (CEGL002467, G5)
- *Populus tremuloides* - *Populus balsamifera* - Mixed Hardwoods Lowland Forest (CEGL005036, G5)
- *Populus tremuloides* - *Betula papyrifera* / (*Abies balsamea*, *Picea glauca*) Forest (CEGL002466, G5)
- *Populus (tremuloides, balsamifera)* - (*Betula papyrifera*) - *Picea mariana* / *Alnus viridis* Forest (CEGL002514, GNR)
- Boreal Glaciere Talus Sparse Vegetation (CEGL005243, G2G3)

High-ranked species: *Botrychium* sp. 3 (G3), *Diplophyllum obtusatum* (G2?)

SOURCES

References: Brandt 2009, Comer et al. 2003, Eyre 1980

Version: 15 Oct 2012

Concept Author: D. Faber-Langendoen and S. Gawler

Stakeholders: Canada, East, Midwest

LeadResp: Midwest

CES103.426 EASTERN HEMI-BOREAL MESIC BALSAM FIR-SPRUCE FOREST

Primary Division: Boreal (103)

Land Cover Class: Forest and Woodland

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Concept Summary: This ecological system represents the mesic southern or hemi-boreal eastern boreal forest, ranging from northwestern Ontario to eastern Canada's Atlantic provinces and extending into the U.S. in northeastern Minnesota, Isle Royale, and near-coastal areas of Lake Superior shores in northern Wisconsin and Michigan. The low-elevation forests are dominated by *Picea glauca* and *Abies balsamea*. *Picea mariana* is often present, along with occasional *Pinus banksiana*. Codominant boreal hardwoods include *Populus tremuloides* and *Betula papyrifera*. Northern hardwoods, such as *Acer saccharum* and *Tilia americana* are relatively minor. The shrub and herb layers are variable, decreasing as the percent conifer cover increases. Common shrub species include *Acer spicatum*, *Alnus viridis*, *Corylus cornuta*, *Diervilla lonicera*, and *Lonicera canadensis*. The moss layer ranges from discontinuous to continuous. These upland forests typically occur on loamy soils over bedrock in scoured bedrock uplands and loamy, rocky, or sandy soils on glacial moraines, till plains and outwash plains, and moisture conditions range from well-drained to somewhat poorly drained. Wetter sites may contain *Alnus incana* ssp. *rugosa*, *Calamagrostis canadensis*, and *Equisetum* spp. This is the matrix forest type in many parts of its range. This group may include earlier-successional patches, in which *Populus* spp. and *Betula* spp. are dominant or mixed with *Picea* and *Abies*, that will develop into spruce-fir forests. Blowdown with subsequent gap regeneration is the most frequent form of natural disturbance, with large-scale fires important at longer return intervals. Insect infestations, in particular by *Choristoneura fumiferana* (spruce budworm), also can impact this group.

Comments: The transition zone from the Boreal (including hemi-boreal) Forest formation (where *Abies balsamea* is the dominant tree species) to the Cool Temperate Forest (where *Acer saccharum* is the dominant tree species) is difficult to untangle, but depends on the increasing abundance of northern hardwood tree species and more cool-temperate shrubs and herbs. Where these species occur with the boreal conifers, they are placed in 1.B.2 Cool Temperate Forest Formation (F008). Forest associations typical of this transition zone are mixedwood associations dominated by *Betula alleghaniensis* or *Acer rubrum* and *Abies balsamea* or *Acer rubrum* and *Abies balsamea*. These associations are currently placed in Cool Temperate Forest under Sub-Boreal Mesic Fir - Yellow Birch - Hardwoods Forest (CES103.434). In Quebec (C. Morneau pers. comm. 2009), the most northerly cool temperate transition zone extends between 47 degrees N latitude and 49 degrees N latitude, including Bas-St. Laurent and Gaspesie regions.

A separate aspen-birch system is recognized in the eastern hemi-boreal region, Eastern Hemi-Boreal Aspen-Birch Forest (CES103.020), though these are lumped together at the group level (G048).

DISTRIBUTION

Range: This system ranges in Canada from northwestern Ontario (possibly eastern Manitoba) to eastern Canada's Atlantic provinces and extending into the U.S. in northeastern Minnesota, Isle Royale, and near-coastal areas of Lake Superior shores in northern Wisconsin and Michigan. Its range westward is marked by a shift towards greater *Picea glauca* dominance and lower *Abies balsamea* dominance.

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

Nations: CA, US

Subnations: LB, MB?, MI, MN, NB?, NF, ON, QC, WI

CONCEPT

Associations:

Environment: These upland forests typically occur on loamy soils over bedrock in scoured bedrock uplands and loamy, rocky, or sandy soils on glacial moraines, till plains and outwash plains (Minnesota DNR 2003). Moisture conditions range from well-drained to

somewhat poorly drained. Climate typically is characterized by cool, even temperatures, shorter growing season, and deep and sometimes severe winter snowfall. In the southern part of their range in the Great Lakes states, they occur along northern Great Lakes shorelines and on islands in Lake Superior. Cold temperate to boreal. Soils are typically neutral to acidic, shallow sandy, sandy-loam, or loamy-sand. Some examples occur on heavier, mesic silty or clay loams that are more alkaline in nature. Along Great Lakes shorelines, these soils overlay limestone or volcanic bedrock.

Vegetation: *Picea glauca* typically dominates on drier sites or is codominant with *Abies balsamea* on more mesic sites. In some mesic to wet-mesic examples, *Abies balsamea* dominates. This group includes several successional stages, including earlier-successional patches in which *Populus* spp. and *Betula* spp. are dominant. Mid-successional stands often contain stands mixed with *Picea* and *Abies*, that will develop into spruce-fir forests. The shrub and herb layers are variable, decreasing as the percent conifer cover increases. Common shrub species include *Acer spicatum*, *Corylus cornuta*, *Diervilla lonicera*, and *Lonicera canadensis*. The composition and density of the herbaceous layer can vary among associations and location. Typically, *Aralia nudicaulis*, *Eurybia macrophylla*, *Clintonia borealis*, and *Maianthemum canadense* are common understory species. The moss layer ranges from discontinuous to continuous. Wetter sites may contain *Alnus incana* ssp. *rugosa*, *Calamagrostis canadensis*, and *Equisetum* spp. Additional diagnostic shrub and herb species of this hemi-boreal type will be added through further analyses.

Dynamics: These forests are affected by windthrow, insect defoliation, and infrequent fires. Forests closer to the Great Lakes shorelines occur on shallower soils and are more likely to experience more serious windthrow and snap-off of larger trees. Mammalian herbivory also can impact forest stands. Selective herbivory by white-tailed deer and moose (*Alces americanus*) can alter the composition and structure and favor browse-tolerant species such as *Picea glauca*. These forests typically regenerate from gap-phase dynamics.

SOURCES

References: Curtis 1959, Eyre 1980, Faber-Langendoen et al. 2013, Heinselman 1996, Kost et al. 2007, Minnesota DNR 2003, NatureServe n.d., Wisconsin DNR 2009a

Version: 05 Sep 2012

Stakeholders: Canada, Midwest

Concept Author: Faber-Langendoen, in Faber-Langendoen et al. (2012)

LeadResp: Midwest

G347. Eastern Hemi-Boreal Dry Jack Pine - Red Pine - Hardwood Woodland

CES103.499 BOREAL DRY JACK PINE WOODLAND

Primary Division: Boreal (103)

Land Cover Class: Forest and Woodland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Forest and Woodland (Treed); Boreal [Boreal Continental]; Acidic Soil; Sand Soil Texture; F-Landscape/High Intensity; Needle-Leaved Tree

Concept Summary: This conifer woodland system is found on nutrient-poor soils in a variety of topographic settings in the central and northwestern boreal regions of Canada. It ranges from western Alberta to eastern Canada, and possibly southward into Minnesota and the Great Lakes region. Soils are loamy to sandy, varying from thin soil over bedrock to deeper soils, sometimes sandy. Sites are xeric, but less strongly than barrens and sandplains. Outwash plains have deeper soils. In western Alberta, this system occurs on the upland portions of vegetated dunefields, with a variety of wetland systems found in the swales. *Pinus banksiana* is the predominant overstory species, with a canopy structure that is mostly closed but can be partially open. *Populus tremuloides* or *Betula papyrifera* may occur in the canopy, but this is predominantly a conifer forest type. As time since fire increases, *Picea mariana* may dominate. The shrub and field layers can be somewhat dense to sparse, and older stands may be dominated by feathermosses. Important shrubs include *Arctostaphylos uva-ursi*, *Vaccinium vitis-idaea*, and *Diervilla lonicera*. The dominant fire regime varies from 50-100 years.

Comments: Additional information about the distribution and characteristics of this system is needed. In particular, its relationship to Boreal Jack Pine-Black Spruce Forest (CES103.022) needs to be clarified. Open bedrock-conifer woodlands are treated under Laurentian Acidic Rocky Outcrop (CES201.019). In Minnesota and the Great Lakes region, jack pine and red pine stands on sand also occur in Laurentian Pine-Oak Barrens (CES201.718). Compare also with Acadian Sub-boreal Spruce Barrens (CES201.561), which occur in similar settings but lack jack pine.

DISTRIBUTION

Range: It ranges from western Alberta to eastern Canada, and possibly southward into Minnesota and the Great Lakes region. It may also occur as far north and west as the Northwest Territories, the furthest west of *Pinus banksiana* occurrence.

Divisions: 103:C, 201:C

TNC Ecoregions: 47:C, 48:C, 63:C, 139:P, 140:C, 141:P

Nations: CA, US?

Subnations: AB, MB, ME?, MI?, MN?, ON, QC, SK

Map Zones: 41:C, 50:C, 51:C, 66:P

USFS Ecomap Regions: 212H:CC, 212J:CC, 212L:CC, 212M:CC, 212R:CC, 212S:CC, 212T:CC, 212X:CC, 222Ue:CC?

CONCEPT**Associations:**

- *Pinus banksiana* / *Arctostaphylos uva-ursi* Forest (CEGL002438, G4G5)
- *Pinus banksiana* / *Vaccinium* spp. / *Pleurozium schreberi* Forest (CEGL002441, G4G5)
- *Pinus banksiana* - *Populus tremuloides* / *Diervilla lonicera* Forest (CEGL002518, G4G5)

SOURCES

References: Comer et al. 1995a, Comer et al. 1998, Frelich 1992, Heinselman 1973, Western Ecology Working Group n.d., Willoughby et al. 2006

Version: 30 Mar 2010

Stakeholders: Canada, East, Midwest

Concept Author: D. Faber-Langendoen

LeadResp: Midwest

CES103.424 EASTERN HEMI-BOREAL DRY JACK PINE-RED PINE-HARDWOOD WOODLAND

Primary Division: Boreal (103)

Land Cover Class: Forest and Woodland

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Concept Summary: This conifer woodland is found throughout the eastern southern or hemi-boreal regions of eastern Canada, extending into the Upper Midwest and Northeast parts of the United States. It occurs on dry nutrient-poor sand plains and along rocky ridges, often adjacent to rivers and lakes, and along talus slopes. The canopy ranges from patchy to continuous and is dominated by a mix of primarily conifer and hardwood species. In some examples, canopy trees may be stunted. *Pinus banksiana* is the most frequent conifer species, although *Pinus resinosa*, *Pinus strobus*, *Picea mariana*, or *Picea glauca* can be common and may dominate some sites. Hardwood species vary in cover from 25-90% of the canopy. *Quercus ellipsoidalis* is a restricted dominant in the Midwest part of the range of this system, along with *Quercus macrocarpa* and *Quercus rubra*. More common are *Betula papyrifera* and *Populus* spp. In areas of open bedrock, species typical of bedrock outcrops and shallow soils can be found and include *Danthonia spicata*, *Poa alsodes*, *Elymus trachycaulus* (= *Agropyron trachycaulum*), *Maianthemum canadense*, *Schizachne purpurascens*, and *Oryzopsis asperifolia*. The nonvascular layer can be absent or present with up to 30% cover. In the open bedrock areas, this layer consists mainly of the lichens and mosses. Infrequent fire is the primary dynamic, with catastrophic fires occurring approximately every 150-200 years with surface fires every 50-200 years.

DISTRIBUTION

Range: This system ranges in Canada from northwestern Ontario (possibly eastern Manitoba) to eastern Canada's Atlantic provinces and extending into the U.S. in northeastern Minnesota, Isle Royale, and near-coastal areas of Lake Superior shores in northern Wisconsin and Michigan.

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

Nations: CA, US

Subnations: LB?, MB?, MI, MN, NB, NF, ON, QC, WI

CONCEPT**Associations:**

Environment: Examples of this system occur on rocky ridgetops, high slopes, and terraces sometimes along rivers or lakeshores, including Great Lakes shorelines. These areas are dry, well-drained sites, often with exposed bedrock. Soils range from bare bedrock and talus slopes to rocky, shallow loams and deep sands. Those stands on bedrock may have occasional cracks in the underlying bedrock resulting in pockets of relatively deep (15-20 cm) soil. Bare rock (with crustose lichens) can cover up to 50% of the area.

Vegetation: The canopy ranges from scattered trees to a moderately dense canopy. Stands are a mix of conifer species, occasionally with hardwood species. In some examples, canopy trees may be stunted. The conifers in most examples are dominated by *Pinus banksiana*. *Pinus resinosa*, *Pinus strobus*, *Picea mariana*, or *Picea glauca* can be common and may dominate some sites. Hardwood species vary in cover from 25-90% of the canopy. *Quercus ellipsoidalis* is a restricted dominant in the Midwest part of the range, with *Quercus macrocarpa* or *Quercus rubra*, *Betula papyrifera*, and *Populus* spp. occurring more commonly. Shrubs may be absent to dense and include *Amelanchier* spp., *Diervilla lonicera*, *Corylus cornuta*, *Juniperus communis*, *Prunus pensylvanica*, *Salix bebbiana*, and *Vaccinium angustifolium*. Herbaceous species vary across the range of this type. Some typical species include *Danthonia spicata*, *Poa alsodes*, *Elymus trachycaulus* (= *Agropyron trachycaulum*), *Maianthemum canadense*, *Schizachne purpurascens*, and *Oryzopsis asperifolia*. The nonvascular layer can be absent or present with up to 30% cover. In the open bedrock areas, this layer consists mainly of the lichens and mosses. Lichen species may include *Cladonia rangiferina* (= *Cladonia rangiferina*) and *Cladonia mitis* (= *Cladonia mitis*). Mosses include *Dicranum* spp., *Pleurozium schreberi*, and *Polytrichum* spp.

SOURCES

References: Faber-Langendoen et al. 2013, Kost et al. 2007, Midwestern Ecology Working Group n.d., Minnesota DNR 2003, NatureServe n.d.

Version: 29 Aug 2012

Stakeholders: Canada, East, Midwest

Concept Author: Faber-Langendoen, in Faber-Langendoen et al. (2012)

LeadResp: Midwest

1.B.5. BOREAL FLOODED & SWAMP FOREST

1.B.5.Na. North American Boreal Flooded & Swamp Forest

M299. NORTH AMERICAN BOREAL BOG & SWAMP FOREST

G050. Eastern Black Spruce - Tamarack Acidic Swamp & Bog Forest

CES103.724 BOREAL-LAURENTIAN CONIFER ACIDIC SWAMP AND TREED POOR FEN

Primary Division: Boreal (103)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland

Concept Summary: This ecological system extends across the boreal regions of central and western Canada, and east and south into northern New England and the Great Lakes region. The system is primarily weakly to moderately minerotrophic (poor fen), though some stands may approach ombrotrophic (bog) conditions. Decomposition is so slow that fibrous or woody peat accumulates, and the water is slightly to very acidic and nutrient-poor (also called mesotrophic). Acidic (also called poor or transitional) fens have organic soils and are dominated by aquatics, emergents, and dwarf-shrubs, or raised peat dominated by shrubs and trees. Groundwater, the primary water source, is nutrient-rich due to its contact with mineral soils, however, acidic fens have less contact with nutrient-rich waters, as the amount of peat has accumulated to raise the level of the fen, but it remains in contact with groundwater (hence "transitional" on its way to becoming a bog). The water is acidic, with a pH generally between 4.0 and 5.8. This is a forested peatland where the trees form partial to full cover over most or all of the peatland. Stunted to well-developed *Picea mariana* and *Larix laricina* are the dominant trees. Heaths and sedges are common in the understory, but the dwarf-shrub layer is less well-developed than in open acidic peatlands, though it may be prominent in more open parts of the system. *Chamaedaphne calyculata*, *Kalmia polifolia*, *Ledum groenlandicum*, *Vaccinium macrocarpon* (= *Oxycoccus macrocarpus*), *Vaccinium vitis-idaea*, and *Salix* spp. are the dominant dwarf-shrubs. Other fen indicators also occur, such as *Betula glandulosa* or *Betula pumila*. Other poor fens are graminoid-dominated with herbaceous indicators such as *Drosera* spp., *Equisetum fluviatile*, *Maianthemum trifolium*, *Sarracenia purpurea*, and sedges (*Carex* spp.)

Comments: This forested system is most common in poorly drained basins, with some minerotrophic influence. It is sometimes referred to as "muskeg," a flat bog peatland with scattered trees and a fairly dense shrub layer on mounded or hummocky peat, though this system is not, technically, an ombrotrophic bog [see Boreal-Laurentian Bog (CES103.581)]. Muskeg is probably a complex of bogs and acidic swamps. Black spruce swamps in northeastern Vermont, northern New Hampshire, Adirondack region of New York, and Maine are included here. There appears to be no need for a true Boreal alkaline swamp system, but further review is needed. In Acadia and the Northern Appalachian regions, this system is mostly replaced by the sub-boreal Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp (CES201.574). Small kettlehole bogs in the northeastern U.S. are attributed to North-Central Interior and Appalachian Acidic Peatland (CES202.606). In western Canada, this system is uncommon because the substrates are mostly calcareous, resulting in a preponderance of rich, alkaline fens either dominated by *Larix laricina* with some *Picea mariana*, or else shrub-sedge fens lacking trees.

DISTRIBUTION

Range: This system is found in central and eastern Canada, extending into northern New England and the Great Lakes region, particularly in northern Minnesota.

Divisions: 103:C, 201:C

TNC Ecoregions: 47:C, 48:C, 63:C, 137:?, 140:C, 141:C

Nations: CA, US

Subnations: AB, MB, ME, MI, MN, NB, NH, NS, NY, ON, PE?, SK, VT, WI

Map Zones: 40:C, 41:C, 50:C, 51:C, 64:C, 66:C

USFS Ecomap Regions: 211A:CC, 211B:CC, 211C:CC, 211D:CC, 212Ha:CCC, 212Hb:CCC, 212Hc:CCC, 212Hd:CCC, 212He:CCC, 212Hf:CCC, 212Hg:CCC, 212Hh:CCC, 212Hi:CCC, 212Hj:CCC, 212Hk:CCC, 212Hl:CCC, 212Hm:CCC, 212K:CC, 212L:CC, 212M:CC, 212N:CC, 212Ra:CCC, 212Rb:CCC, 212Rc:CCC, 212Rd:CCC, 212Re:CCC, M211A:CC, M211B:CC, M211C:CC, M211D:CC

CONCEPT

Associations:

- *Carex lasiocarpa* - *Carex oligosperma* / *Sphagnum* spp. Herbaceous Vegetation (CEGL002265, G3G4)
- *Picea mariana* / *Alnus incana* / *Sphagnum* spp. Forest (CEGL002452, G5)
- *Picea mariana* / *Ledum groenlandicum* / *Carex trisperma* / *Sphagnum* spp. Forest (CEGL002485, G5)
- *Larix laricina* / *Chamaedaphne calyculata* / *Carex lasiocarpa* Shrubland (CEGL005226, G4G5)
- *Picea mariana* - (*Larix laricina*) / *Ledum groenlandicum* / *Sphagnum* spp. Forest (CEGL005271, G5)

- *Chamaedaphne calyculata* / *Carex oligosperma* / *Sphagnum* spp. Poor Fen Dwarf-shrubland (CEGL005277, G5)
- *Pinus banksiana* - (*Picea mariana*) - Mixed Hardwoods / *Sphagnum* spp. Forest (CEGL005166, GNRQ)

High-ranked species: *Appalachia arcana* (G2G3), *Callophrys lanoraieensis* (G3G4)

SOURCES

References: Comer et al. 2003, Eyre 1980, Glaser and Janssens 1986, Harris et al. 1996, Kost et al. 2007, Smith et al. 2007

Version: 31 Mar 2010

Stakeholders: Canada, East, Midwest

Concept Author: D. Faber-Langendoen

LeadResp: Midwest

M300. NORTH AMERICAN BOREAL FLOODED FOREST

G052. Eastern Boreal Hardwood Floodplain & Swamp

CES103.588 EASTERN BOREAL FLOODPLAIN

Primary Division: Boreal (103)

Land Cover Class: Mixed Upland and Wetland

Spatial Scale & Pattern: Linear

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland

Diagnostic Classifiers: Forest and Woodland (Treed); Riverine / Alluvial; Flood Scouring; *Picea* (*glauca*, *mariana*, *rubens*) - *Abies*; Short (<5 yrs) Flooding Interval [Short interval, Spring Flooding]

National Mapping Codes: EVT 2444; ESLF 9113; ESP 1444

Concept Summary: These southern boreal floodplains are found in the extreme northern portions of the eastern U.S., and believed to be more widespread in Canada. They consist of floodplains along medium-sized northern rivers, in areas not strongly influenced by ice-scour (i.e., depositional), where topography and process have resulted in a complex of upland and wetland alluvial vegetation. This complex includes floodplain forests dominated by northern trees such as *Populus balsamifera* and *Fraxinus nigra*, as well as herbaceous sloughs and shrub wetlands. (*Acer saccharinum* is uncommon or absent.) Most areas are underwater each spring; microtopography determines how long the various habitats are inundated. The distribution in Division 201 appears to be primarily Canadian, with incursions into northern Maine and northern Minnesota.

Comments: Where this system transitions to Western Canadian Boreal Mixed Hardwood-Conifer Swamp and Floodplain (CES103.523) is not clear, and perhaps they should be combined. As written, this system does have some different floristics than the western boreal one.

DISTRIBUTION

Range: This system is found primarily in eastern Canada, with distribution extending into far-northern New England and the northern Great Lakes region.

Divisions: 103:C, 201:C

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

Nations: CA, US

Subnations: ME, MI, MN, NB, NH, NY, ON, QC, VT

Map Zones: 40:?, 41:P, 50:P, 51:P, 63:P, 64:P, 66:C

USFS Ecomap Regions: 212J:CP, 212L:CP, 212M:CP, 212N:CP, 212R:CP, 212S:CP, 212T:CP, 212X:CP, 212Y:CP

CONCEPT

Associations:

- *Cornus sericea* - *Salix* spp. - (*Rosa palustris*) Shrubland (CEGL002186, G5)
- *Fraxinus nigra* - Mixed Hardwoods - Conifers / *Cornus sericea* / *Carex* spp. Forest (CEGL002105, G4)
- River Mudflats Sparse Vegetation (CEGL002314, GNR)
- *Populus balsamifera* - *Fraxinus nigra* / *Matteuccia struthiopteris* Forest (CEGL006432, GNR)
- *Calamagrostis canadensis* - *Eupatorium maculatum* Herbaceous Vegetation (CEGL005174, G4G5)
- *Acer rubrum* - *Abies balsamea* / *Viburnum nudum* var. *cassinoides* Floodplain Forest (CEGL006501, GNR)

High-ranked species: *Glyptemys insculpta* (G3)

SOURCES

References: Comer et al. 2003, Eyre 1980, Gawler and Cutko 2010

Version: 09 Jan 2003

Stakeholders: Canada, East, Midwest

Concept Author: S.C. Gawler

LeadResp: East

2. SHRUBLAND & GRASSLAND

2.B. Temperate & Boreal Grassland & Shrubland

2.B.2. TEMPERATE GRASSLAND, MEADOW & SHRUBLAND

2.B.2.Nb. Great Plains Grassland & Shrubland

M054. GREAT PLAINS TALLGRASS PRAIRIE & SHRUBLAND

G075. Northern Great Plains Tallgrass Prairie

CES205.686 NORTHERN TALLGRASS PRAIRIE

Primary Division: Eastern Great Plains (205)

Land Cover Class: Herbaceous

Spatial Scale & Pattern: Matrix

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

National Mapping Codes: EVT 2420; ESLF 7133; ESP 1420

Concept Summary: This system is found primarily in the Northern Tallgrass ecoregion ranging along the Red River basin in Minnesota and the Dakotas to Lake Manitoba in Canada. It constitutes the northernmost extension of the "true" prairies. Similar to Central Tallgrass Prairie (CES205.683), this system is dominated by tallgrass species such as *Andropogon gerardii*, *Sorghastrum nutans*, and *Panicum virgatum*. However, the soils in this region are not as rich nor deep, and thus this system does not have as much species diversity as grasslands to the south. This system is often found on well-drained, drier soils and can grade into Eastern Great Plains Tallgrass Aspen Parkland (CES205.688) to the north and east. Grazing and fire influenced this system historically. Much of this system has been converted to agriculture with very few unaltered and highly fragmented examples remaining.

DISTRIBUTION

Range: Found primarily in the Northern Tallgrass ecoregion ranging along the Red River basin in Minnesota and the Dakotas to Lake Manitoba in Canada.

Divisions: 205:C

TNC Ecoregions: 35:C

Nations: CA, US

Subnations: IA, MB, MN, ND, SD

Map Zones: 39:C, 40:C, 41:?, 42:C

USFS Ecomap Regions: 222N:CC, 251A:CC, 251B:CC, 251G:CC, 251H:C?, 332B:CC, 332D:CC

CONCEPT

Associations:

- *Andropogon gerardii* - (*Panicum virgatum*) - *Muhlenbergia richardsonis* Herbaceous Vegetation (CEGL002199, G3G4)
- *Andropogon gerardii* - *Hesperostipa spartea* - *Sporobolus heterolepis* Herbaceous Vegetation (CEGL002202, G2G3)
- *Schizachyrium scoparium* - *Bouteloua curtipendula* - *Hesperostipa spartea* - (*Pascopyrum smithii*) Herbaceous Vegetation (CEGL002377, G3?)
- *Schizachyrium scoparium* - *Bouteloua curtipendula* Loess Mixedgrass Herbaceous Vegetation (CEGL002036, G3?)
- *Carex prairea* - *Schoenoplectus pungens* - *Rhynchospora capillacea* Herbaceous Vegetation (CEGL002267, G2)
- *Populus tremuloides* - *Quercus macrocarpa* - *Salix* spp. / *Andropogon gerardii* Shrubland (CEGL002182, G2G3)

High-ranked species: *Hesperia dacotae* (G2), *Oarisma poweshiek* (G1), *Speyeria idalia* (G3)

SOURCES

References: Barbour and Billings 1988, Comer et al. 2003, Ricketts et al. 1999

Version: 05 Mar 2003

Concept Author: S. Menard

Stakeholders: Canada, Midwest

LeadResp: Midwest

G151. Sand & Gravel Tallgrass Prairie

CES202.695 NORTH-CENTRAL INTERIOR SAND AND GRAVEL TALLGRASS PRAIRIE

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Herbaceous

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

National Mapping Codes: EVT 2412; ESLF 7125; ESP 1412

Concept Summary: This system is found in the northern Midwest, particularly in Minnesota, Wisconsin, Michigan, and possibly ranging into Ontario. It is often found on glacial features such as kames, eskers, moraines, lakeplains (though excluding the Great Lakes lakeplain) and sandplains, and along eolian dunes. In contrast to the deeper, richer soils supporting other tallgrass systems in the region, the underlying soils in this system tend to be more shallow, sandy, rocky, and/or gravelly outwash soils. Organic content is significantly lower. Grassland species such as *Schizachyrium scoparium*, *Andropogon gerardii*, and *Bouteloua* spp., varying in cover from sparse to moderately dense, dominate this system. *Hesperostipa spartea* and *Sporobolus heterolepis* are also common components of this system. Woody species more tolerant of droughty conditions may be found in some examples. The most common trees are *Pinus banksiana*, *Quercus ellipsoidalis*, *Quercus macrocarpa*, and *Populus tremuloides*. Fire and drought are the major dynamics influencing this system. If fire and periodic drought are not present, woody species begin to invade this system, especially in the eastern parts of its distribution. Wind can also play a role, especially on examples found on sandplains and/or eolian dunes.

DISTRIBUTION

Range: This system is found in the northern Midwest possibly ranging into Ontario.

Divisions: 202:C, 205:P

TNC Ecoregions: 35:C, 36:P, 45:C, 46:C, 47:C, 48:C

Nations: CA, US

Subnations: IA, IL, IN, MI, MN, MO, ND, ON, SD, WI

Map Zones: 39:C, 40:C, 41:P, 42:C, 43:P, 49:P, 50:C, 51:C, 52:C

USFS Ecomap Regions: 212Ha:CCC, 212Hb:CCC, 212Hc:CCC, 212Hd:CCC, 212He:CCC, 212Hf:CCC, 212Hg:CCC, 212Hh:CCP, 212Hi:CCC, 212Hk:CCC, 212Hm:CCP, 212K:CP, 212M:CP, 212N:CP, 212Tb:CCC, 222Ja:CCC, 222Jb:CCC, 222Jc:CCC, 222Je:CCC, 222Jf:CCP, 222Jg:CCC, 222Jh:CCC, 222Ji:CCP, 222K:CC, 222L:CC, 222M:CC, 222N:CC, 222R:CP, 222Ua:CCC, 222Ud:CCP, 222Ue:CCP, 251A:CC, 251B:CC

CONCEPT

Associations:

- *Schizachyrium scoparium* - *Danthonia spicata* - *Carex pensylvanica* - (*Viola pedata*) Herbaceous Vegetation (CEGL002318, G2G3)
- *Schizachyrium scoparium* - *Bouteloua curtipendula* Gravel Herbaceous Vegetation (CEGL002215, G3)
- *Schizachyrium scoparium* - *Sorghastrum nutans* - *Andropogon gerardii* - *Lespedeza capitata* Sand Herbaceous Vegetation (CEGL002210, G3)
- *Andropogon gerardii* - *Calamagrostis canadensis* Sand Herbaceous Vegetation (CEGL005177, G2G3)
- *Andropogon gerardii* - *Sorghastrum nutans* - *Schizachyrium scoparium* - *Aletris farinosa* Herbaceous Vegetation (CEGL005096, G2)
- *Schizachyrium scoparium* - *Hesperostipa spartea* - *Bouteloua (curtipendula, gracilis)* Sand Herbaceous Vegetation (CEGL005204, G2G3)
- *Schizachyrium scoparium* - *Bouteloua* spp. - *Hesperostipa spartea* Gravel Herbaceous Vegetation (CEGL002499, G2G3)

High-ranked species: *Anisota manitobensis* (G1G2Q), *Dichagyris reliqua* (G2G3), *Erynnis persius persius* (G5T1T3), *Hesperia dacotae* (G2), *Nicrophorus americanus* (G2G3), *Papaipema beeriana* (G2G3), *Sisyrinchium strictum* (G2Q), *Tachysphex pechumani* (G2G3)

Environment: This system is often found on glacial features such as kames, eskers, moraines, lakeplains (though excluding the Great Lakes lakeplain) and sandplains, and along eolian dunes. In contrast to the deeper, richer soils supporting other tallgrass systems in the region, the underlying soils in this system tend to be more shallow, sandy, rocky, and/or gravelly outwash soils. Organic content is significantly lower.

Vegetation: Grassland species such as *Schizachyrium scoparium*, *Andropogon gerardii*, and *Bouteloua* spp., varying in cover from sparse to moderately dense, dominate this system. *Hesperostipa spartea* and *Sporobolus heterolepis* are also common components of this system. Woody species more tolerant of droughty conditions may be found in some examples. The most common trees are *Pinus banksiana*, *Quercus ellipsoidalis*, *Quercus macrocarpa*, and *Populus tremuloides*.

Dynamics: Fire and drought are the major dynamics influencing this system. If fire and periodic drought are not present, woody species begin to invade this system, especially in the eastern parts of its distribution. Wind can also play a role, especially on examples found on sandplains and/or eolian dunes.

SOURCES

References: Comer et al. 2003, MNNHP 1993, Thompson 1940

Version: 18 Jul 2006

Concept Author: S. Menard

Stakeholders: Canada, Midwest, Southeast

LeadResp: Midwest

CES202.704 PALEOZOIC PLATEAU BLUFF AND TALUS

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Steppe/Savanna

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

National Mapping Codes: EVT 2517; ESLF 5430; ESP 1517

Concept Summary: This system is found in the driftless regions of southeastern Minnesota, southwestern Wisconsin, and northern Iowa and Illinois. This region was not glaciated like the surrounding areas and thus is predominated by rolling hills and bluff outcrops. This system is found primarily on bluffs and dry upper slopes along the Upper Mississippi River, although it can range into bordering regions such as the Baraboo Hills in Wisconsin. This system contains a mosaic of woodlands, savannas, prairies and sparsely vegetated limestone, dolomite, and/or sandstone outcrops, with occasional talus, especially algal talus. Soils range from thin to moderately deep and are moderately to excessively well-drained with a high mineral content. Woodlands consist of primarily a mixture of oak species such as *Quercus macrocarpa*, *Quercus rubra*, *Quercus muehlenbergii*, and *Quercus alba*. *Acer saccharum*, *Betula alleghaniensis*, and conifer species such as *Pinus* spp. and *Tsuga canadensis* may occur on more mesic and protected areas within this system. Prairie openings (also called "goat prairies") contain *Schizachyrium scoparium* and *Bouteloua curtipendula* with scattered *Juniperus virginiana*. Historically, fire was the most important dynamic maintaining these systems, however, fire suppression within the region has allowed more canopy cover and thus very few prairie openings remain. Algal talus harbors a number of unusual Pleistocene relict species, including plants and snails.

Comments: This system will need review from Minnesota, Wisconsin, and Iowa to make sure it is correctly characterized.

DISTRIBUTION

Range: This system is found within the Paleozoic Plateau (aka Driftless Region) of southeastern Minnesota, southwestern Wisconsin and northern Iowa and Illinois.

Divisions: 202:C

TNC Ecoregions: 46:C

Nations: US

Subnations: IA, IL, MN, WI

Map Zones: 42:C, 49:C, 50:C

USFS Ecomap Regions: 222L:CC

CONCEPT

Associations:

- *Tsuga canadensis* - *Acer saccharum* / (*Hepatica nobilis* var. *acuta*) Driftless Forest (CEGL002597, G2)
- *Schizachyrium scoparium* - *Bouteloua curtipendula* - *Muhlenbergia cuspidata* - *Symphotrichum sericeum* Alkaline Herbaceous Vegetation (CEGL002403, G2)
- *Schizachyrium scoparium* - *Bouteloua curtipendula* Bedrock Bluff Herbaceous Vegetation (CEGL002245, G3G4)
- *Pinus strobus* - (*Pinus resinosa*) Driftless Bluff Forest (CEGL002378, G2G3)
- *Pinus strobus* - *Abies balsamea* - *Betula alleghaniensis* Driftless Forest (CEGL002111, G2?)
- *Impatiens pallida* - *Cystopteris bulbifera* - *Adoxa moschatellina* - (*Chrysosplenium iowense*, *Aconitum noveboracense*) Herbaceous Vegetation (CEGL002387, G2)
- Maderate Cliff Sparse Vegetation (CEGL002293, G3?)
- *Quercus muehlenbergii* - *Quercus* (*alba*, *velutina*) - (*Juniperus virginiana* var. *virginiana*) Bluff Woodland (CEGL002144, G2G3)

SOURCES

References: Albert 1995b, Comer et al. 2003, Dunevitz pers. comm., Eyre 1980

Version: 05 Mar 2003

Concept Author: S. Menard

Stakeholders: Midwest

LeadResp: Midwest

G333. Central Great Plains Tallgrass Prairie

CES205.683 CENTRAL TALLGRASS PRAIRIE

Primary Division: Eastern Great Plains (205)

Land Cover Class: Herbaceous

Spatial Scale & Pattern: Matrix

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

National Mapping Codes: EVT 2421; ESLF 7134; ESP 1421

Concept Summary: This system is found primarily in the Central Tallgrass Prairie ecoregion ranging from eastern Kansas and Nebraska to northwestern Indiana. This system differs from other prairie systems to the north and south by being the most mesic with primarily deep, rich Mollisol soils. These soils are usually greater than 1 meter deep. This system is dominated by tallgrass species such as *Andropogon gerardii*, *Sorghastrum nutans*, and *Panicum virgatum*. These species typically grow to 1-2 m tall in the rich soils found in this system. Other mid- and shortgrass species, such as *Bouteloua curtipendula*, *Hesperostipa spartea*, and *Schizachyrium scoparium*, are usually present and can be common or locally dominant on patches of this system, particularly slopes or other areas

with drier habitats. Several forb species are also associated with this system making it one of the most diverse grassland systems. As many as 300 herbaceous plant species could occur in this system across its range. The environment and habitat of this system do not prevent invasion by shrubs and trees. High-quality examples of this system have trees and shrubs widely scattered or clustered in areas that are wetter and/or more sheltered from fire than the surrounding grassland. Fire, drought, and grazing are the primary natural dynamics influencing this system and help prevent woody species from invading. However, conversion to agriculture has been the prime disturbance since post-European settlement. The rich soils and long growing season make this an ideal location for farming row crops, and as a result very few examples of this system remain.

DISTRIBUTION

Range: This system is found primarily in the Central Tallgrass Prairie (TNC Ecoregion 36) ranging from eastern Kansas and Nebraska to north-central Missouri and northwestern Indiana. In Missouri, it is attributed to EPA 47d, 47f, 72f.

Divisions: 205:C

TNC Ecoregions: 36:C, 45:C, 46:C

Nations: US

Subnations: IA, IL, IN, KS, MO, NE, WI

Map Zones: 31:?, 38:C, 39:?, 42:C, 43:C, 44:P, 49:C, 50:C, 51:C, 52:C

USFS Ecomap Regions: 222Je:CC?, 222Jg:CC?, 222Jh:CCC, 222K:CC, 223A:CC, 251B:CC, 251C:CC, 251F:CC, 251G:CC, 251H:CC, 255A:CC, 332C:CC, 332D:CC, 332E:CC, 332F:CC

CONCEPT

Associations:

- *Schizachyrium scoparium* - *Bouteloua curtipendula* - *Agrostis hyemalis* - *Eleocharis* spp. Hardpan Herbaceous Vegetation (CEGL002249, G2?)
- *Schizachyrium scoparium* - *Sorghastrum nutans* - *Bouteloua curtipendula* Herbaceous Vegetation (CEGL002214, G2G3)
- *Cornus drummondii* - (*Rhus glabra*, *Prunus* spp.) Shrubland (CEGL005219, GNA)
- *Andropogon gerardii* - *Sorghastrum nutans* - (*Sporobolus heterolepis*) - *Liatris* spp. - *Ratibida pinnata* Herbaceous Vegetation (CEGL002203, G1G2)
- *Schizachyrium scoparium* - *Bouteloua curtipendula* - *Bouteloua hirsuta* - (*Yucca glauca*) Herbaceous Vegetation (CEGL002035, G2)
- *Andropogon gerardii* - *Panicum virgatum* - *Schizachyrium scoparium* - (*Tradescantia tharpaii*) Herbaceous Vegetation (CEGL005231, G3?)
- *Juniperus virginiana* var. *virginiana* / *Schizachyrium scoparium* Semi-natural Forest (CEGL003628, GNA)
- *Schizachyrium scoparium* - *Sorghastrum nutans* - *Bouteloua curtipendula* Hill Herbaceous Vegetation (CEGL005183, G2)
- *Andropogon gerardii* - *Sorghastrum nutans* - *Hesperostipa spartea* Loess Hills Herbaceous Vegetation (CEGL002025, G2)
- *Schizachyrium scoparium* - *Sorghastrum nutans* - *Clinopodium arkansanum* Alkaline Herbaceous Vegetation (CEGL005179, G2)
- *Andropogon gerardii* - *Panicum virgatum* - *Helianthus grosseserratus* Herbaceous Vegetation (CEGL002024, G2G3)

High-ranked species: *Papaipema beeriana* (G2G3), *Papaipema eryngii* (G1G2), *Speyeria idalia* (G3)

Environment: This system differs from other prairie systems to the north and south by being the most mesic with primarily deep, rich Mollisol soils. These soils are usually greater than 1 meter deep.

Vegetation: This system is dominated by tallgrass species such as *Andropogon gerardii*, *Sorghastrum nutans*, and *Panicum virgatum*. These species typically grow to 1-2 m tall in the rich soils found in this system. Other mid- and shortgrass species, such as *Bouteloua curtipendula*, *Hesperostipa spartea*, and *Schizachyrium scoparium*, are usually present and can be common or locally dominant on patches of this system, particularly slopes or other areas with drier habitats. Several forb species are also associated with this system making it one of the most diverse grassland systems. As many as 300 herbaceous plant species could occur in this system across its range. The environment and habitat of this system do not prevent invasion by shrubs and trees. High-quality examples of this system have trees and shrubs widely scattered or clustered in areas that are wetter and/or more sheltered from fire than the surrounding grassland.

Dynamics: Fire, drought, and grazing are the primary natural dynamics influencing this system and help prevent woody species from invading. However, conversion to agriculture has been the prime disturbance since post-European settlement. The rich soils and long growing season make this an ideal location for farming row crops, and as a result very few examples of this system remain. Fire suppression can lead to increased cover of woody species.

SOURCES

References: Barbour and Billings 1988, Comer et al. 2003, Ricketts et al. 1999, Rolfsmeier and Steinauer 2010

Version: 11 Apr 2007

Concept Author: S. Menard

Stakeholders: Midwest, Southeast

LeadResp: Midwest

G334. Southern Great Plains Tallgrass Prairie**CES202.326 OZARK PRAIRIE AND WOODLAND****Primary Division:** Central Interior and Appalachian (202)**Land Cover Class:** Herbaceous**Spatial Scale & Pattern:** Large patch**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Upland**Diagnostic Classifiers:** Herbaceous; Graminoid**National Mapping Codes:** EVT 2508; ESLF 5429; ESP 1508

Concept Summary: This system of prairies and associated woodlands is found in the undissected portions of the Springfield Plateau region of Arkansas, Oklahoma, and Missouri (Ecoregion 39a) (EPA 2004). This region is characterized by broad, level to gently rolling uplands derived from limestone and chert. It is much less rugged than the adjacent mountainous regions and more dissected portions of the Springfield Plateau. In addition, this region receives an annual precipitation total of 5-15 cm (2-6 inches) less than the surrounding regions due to a rainshadow produced by a combination of prevailing western winds and orographic effects. The limestone and chert-derived soils associated with the prairies are thin and droughty. The combined effect of droughty soils, reduced precipitation, and prevailing level topography create conditions highly conducive to the ignition and spread of fires. Stands are typically dominated by *Andropogon gerardii*, *Sorghastrum nutans*, *Panicum virgatum*, and *Schizachyrium scoparium*. Few extant examples of this system remain and most are small and isolated.

Comments: There is little floristic and environmental overlap with the Grand Prairie and calcareous prairies of southern Arkansas. There may be stronger overlap with Southeastern Great Plains Tallgrass Prairie (CES205.685), and further review is needed to verify the distinction between these two systems.

DISTRIBUTION

Range: This system is found in the Springfield Plateau subsection of the Ozark Plateau region of Arkansas, Oklahoma, and Missouri, possibly ranging into a limited area of Kansas.

Divisions: 202:C**TNC Ecoregions:** 38:C**Nations:** US**Subnations:** AR, KS?, MO, OK**Map Zones:** 44:C**USFS Ecomap Regions:** 223A:CC**CONCEPT****Associations:**

- *Schizachyrium scoparium* - *Dichanthelium* spp. - *Buchnera americana* - *Echinacea pallida* Herbaceous Vegetation (CEGL007827, G2G3)
- *Andropogon gerardii* - *Sorghastrum nutans* Unglaciaded Herbaceous Vegetation (CEGL002204, G3)
- *Juncus (acuminatus, brachycarpus)* - *Panicum virgatum* - *Bidens aristosa* - *Hibiscus moscheutos* ssp. *lasiocarpus* Herbaceous Vegetation (CEGL004782, G2G3)
- *Schizachyrium scoparium* - *Bothriochloa laguroides* ssp. *torreyana* - *Croton willdenowii* Herbaceous Vegetation (CEGL008564, G1?)
- *Andropogon gerardii* - *Panicum virgatum* - *Helianthus grosseserratus* Herbaceous Vegetation (CEGL002024, G2G3)

High-ranked species: *Calopogon oklahomensis* (G3), *Eriocaulon koernickianum* (G2), *Silene regia* (G3)

Environment: This region is distinctly bounded by the Boston Mountains to the south. This region is characterized by broad, level to gently rolling uplands derived from limestone and chert. It is much less rugged than the adjacent mountainous regions and more dissected portions of the Springfield Plateau. In addition, this region receives an annual precipitation total of 5-15 cm (2-6 inches) less than the surrounding regions due to a rainshadow produced by a combination of prevailing western winds and orographic effects. The limestone and chert-derived soils associated with the prairies are thin and droughty. The combined effect of droughty soils, reduced precipitation, and prevailing level topography create conditions highly conducive to the ignition and spread of fires. Few extant examples of this system remain and most are small and isolated.

Vegetation: These prairies are typically dominated by *Schizachyrium scoparium*, *Andropogon gerardii*, *Sorghastrum nutans*, and *Panicum virgatum*. Other grasses include *Koeleria macrantha*, *Sporobolus heterolepis*, *Sphenopholis obtusata*, *Dichanthelium* spp., *Aristida purpurascens*, *Panicum brachyanthum*, *Phalaris caroliniana*, *Tripsacum dactyloides*, and *Spartina pectinata*. A rich forb diversity is commonly present and includes *Helianthus mollis*, *Helianthus grosseserratus*, *Rudbeckia subtomentosa*, *Silphium laciniatum*, *Symphyotrichum* spp., *Solidago* spp., *Camassia scilloides*, *Echinacea pallida*, *Callirhoe digitata*, *Asclepias hirtella*, *Eryngium yuccifolium*, *Delphinium carolinianum*, *Castilleja coccinea*, *Calopogon oklahomensis*, *Buchnera americana*, *Dodecatheon meadia*, *Amorpha canescens*, *Tephrosia virginiana*, *Orbexilum pedunculatum*, *Baptisia alba*, *Baptisia bracteata*, *Liatris pycnostachya*, and *Liatris squarrosa* var. *hirsuta* (= *Liatris hirsuta*). Wetter areas support a rich diversity of rushes and sedges, including *Carex bicknellii* var. *opaca* (= *Carex opaca*), *Carex oklahomensis*, *Carex buxbaumii*, *Carex scoparia*, *Carex conjuncta*, *Carex davisii*, *Carex arkansana*, *Eleocharis tenuis* var. *verrucosa*, *Eleocharis wolfii*, and *Rhynchospora macrostachya*.

Dynamics: These prairies and woodlands were historically maintained by frequent fire. Drought cycles and grazing were also likely important ecosystem processes.

SOURCES

References: EPA 2004, Foti pers. comm., Southeastern Ecology Working Group n.d.

Version: 01 Feb 2007

Concept Author: T. Witsell

Stakeholders: Midwest, Southeast

LeadResp: Southeast

CES205.685 SOUTHEASTERN GREAT PLAINS TALLGRASS PRAIRIE

Primary Division: Eastern Great Plains (205)

Land Cover Class: Herbaceous

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Herbaceous; Graminoid

National Mapping Codes: EVT 2423; ESLF 7136; ESP 1423

Concept Summary: This system is found primarily within the Flint Hills and Osage Plains of Kansas and Oklahoma. Small patches can be found in the Ozarks of Missouri and the Arbuckle Mountains of Oklahoma. In southern Oklahoma and Texas, this is the primary natural system of the "Grand Prairie" or "Fort Worth Prairie," ranging south into the Lampasas Cutplain of Texas (EPA 29d and 29e, respectively). It is distinguished from Central Tallgrass Prairie (CES205.683) by having more species with southwestern geographic affinities and the presence of a thin soil layer over limestone beds ranging to more acidic substrates, although some areas of deeper soil are found within the region, especially on lower slopes, draws, and terraces. Because of the presence of the rocky substrate close to the surface and the rolling topography, this area is relatively unsuitable for agriculture. The Flint Hills contain one of the largest remaining, relatively intact pieces of tallgrass prairie. The vegetation in this system is typified by tallgrass species such as *Andropogon gerardii*, *Panicum virgatum*, *Schizachyrium scoparium*, and *Sorghastrum nutans* forming a dense cover. A moderate to high density of forb species also occurs. Species composition varies geographically, with *Oligoneuron rigidum* (= *Solidago rigida*), *Liatris punctata*, *Symphotrichum ericoides*, *Lespedeza capitata*, and *Viola pedatifida* occurring in some localities. Areas of deeper soil, especially lower slopes along draws, slopes and terraces, can include *Baptisia alba* var. *macrophylla*, *Liatris pycnostachya*, and *Vernonia missurica*. Shrub and tree species are relatively infrequent and, if present, constitute less than 10% cover in the area. Fire and grazing constitute the major dynamic processes for this region. Although many of the native common plant species still occur, grazing does impact this region. Poor grazing practices can lead to soil erosion and invasion by cool-season grasses such as *Bromus inermis* within its range.

Comments: This includes the Flint Hills, in addition to prairies in Oklahoma and Missouri south of the glacial line (including Ozarks of Missouri). There may need to be further review concerning the prairies in Missouri and Oklahoma. Southeastern Great Plains Tallgrass Prairie (CES205.685) lies to the west of the floristically related Texas Blackland Tallgrass Prairie (CES205.684), and is more widespread, ranging from Texas north to Kansas.

DISTRIBUTION

Range: This system is found primarily within the Flint Hills and Osage Plains of Kansas and Oklahoma. Small patches can be found in the Ozarks of Missouri and the Arbuckle Mountains of Oklahoma. In southern Oklahoma and Texas, this is the primary natural system of the "Grand Prairie" or "Fort Worth Prairie," ranging south into the Lampasas Cutplain of Texas (EPA 29d and 29e, respectively). In Missouri, it is attributed to EPA 40c, 40d, and possibly 39k.

Divisions: 205:C

TNC Ecoregions: 32:C, 36:C, 37:C, 38:P

Nations: US

Subnations: KS, MO, OK, TX

Map Zones: 32:P, 35:C, 38:P, 43:C, 44:C

USFS Ecomap Regions: 223A:PP, 251E:CC, 251F:CC, 251G:CC, 251H:CC, 255A:CC, 255E:CC, 332E:CC

CONCEPT

Associations:

- *Schizachyrium scoparium* - *Sorghastrum nutans* - *Danthonia spicata* - *Silene regia* Chert Herbaceous Vegetation (CEGL002211, G3)
- *Schizachyrium scoparium* - *Sorghastrum nutans* - *Andropogon ternarius* - *Coreopsis grandiflora* Sandstone - Shale Herbaceous Vegetation (CEGL002212, G3)
- *Schizachyrium scoparium* - *Aristida dichotoma* - *Croton willdenowii* / Lichens Wooded Herbaceous Vegetation (CEGL002242, G3)
- *Bouteloua curtipendula* - *Bouteloua (eriopoda, gracilis)* Herbaceous Vegetation (CEGL002250, G4)
- *Schizachyrium scoparium* - *Sorghastrum nutans* - *Tradescantia bracteata* Alkaline Bedrock Herbaceous Vegetation (CEGL005280, G1G2)
- *Andropogon gerardii* - *Sorghastrum nutans* Unglaciated Herbaceous Vegetation (CEGL002204, G3)
- *Juniperus virginiana* var. *virginiana* / *Schizachyrium scoparium* Semi-natural Forest (CEGL003628, GNA)

- *Schizachyrium scoparium* - (*Sorghastrum nutans*) - *Sporobolus compositus* var. *compositus* - *Liatris mucronata* Herbaceous Vegetation (CEGL004211, GNR)
- *Andropogon gerardii* - *Sorghastrum nutans* - *Schizachyrium scoparium* Flint Hills Herbaceous Vegetation (CEGL002201, G4?)
- *Muhlenbergia reverchonii* - *Croton monanthogynus* Herbaceous Vegetation (CEGL004785, G2G3)
- *Schizachyrium scoparium* - *Bouteloua curtipendula* - *Rudbeckia missouriensis* - *Mentzelia oligosperma* Wooded Herbaceous Vegetation (CEGL002251, G2)
- *Juniperus ashei* / *Bouteloua (curtipendula, hirsuta)* Woodland (CEGL002125, G2G3)
- *Andropogon gerardii* - *Panicum virgatum* - *Helianthus grosseserratus* Herbaceous Vegetation (CEGL002024, G2G3)

High-ranked species: *Hesperia attalus attalus* (G2G4T2T4), *Silene regia* (G3), *Speyeria idalia* (G3)

Environment: This system is typified by a thin soil layer over limestone beds or acidic substrates such as chert or granite, although areas of deeper soils are possible along lower slopes, draws, and terraces. The topography is rolling and mostly unsuitable for agriculture. The typical geology is Lower Cretaceous formations, including various limestones, sands (such as from the Paluxy and Antlers formations), and clays (such as from the Walnut Formation). In contrast to Blackland Prairie, landform surfaces are flat rather than undulating, and valley slopes are angular rather than rounded. The "cuesta" landforms with gentle slopes leading up to relatively abrupt escarpments are characteristic of this portion of the Southeastern Great Plains Tallgrass Prairie. Soils of the Southeastern Great Plains Tallgrass Prairie in Texas differ from those of the Southern Blackland Prairie in being browner in color and containing more rock fragments, though much of the region occupied by this prairie is included in the Blackland Ecological Site. Clay Loam, Sandy Loam, Shallow, and Claypan Prairie are also significant Ecological Sites for this system. Soils of this area are more frequently characterized as Mollisols, as opposed to the Vertisols more characteristic of the Blackland Prairie. Calcareous clays are commonly encountered (Elliott 2011).

Vegetation: *Schizachyrium scoparium* tends to dominate examples of this system, with *Bouteloua curtipendula* as another significant component. Other grasses that are frequently present include *Nassella leucotricha*, *Bothriochloa laguroides* ssp. *torreyana*, *Aristida* spp., *Andropogon gerardii*, *Andropogon ternarius*, *Aristida dichotoma*, *Buchloe dactyloides*, *Sporobolus compositus*, *Bouteloua eriopoda*, *Bouteloua gracilis*, *Bouteloua hirsuta*, *Sorghastrum nutans*, *Muhlenbergia reverchonii*, *Chloris verticillata*, and *Erioneuron pilosum*. Forb species such as *Symphyotrichum ericoides*, *Ambrosia psilostachya*, *Tragia ramosa*, *Amphiachyris dracunculoides*, *Dyschoriste linearis*, *Salvia texana*, *Oenothera* spp., *Hedyotis nigricans* var. *nigricans* (= *Stenaria nigricans* var. *nigricans*), *Lindheimera texana*, *Thelesperma* spp., *Dalea* spp., and *Psoralidium* spp. may be encountered (Elliott 2011). Occurrences often contain, and are sometimes dominated by, the non-native grass *Bothriochloa ischaemum* var. *songarica* and/or *Cynodon dactylon*. Other forb species that can occur include *Oligoneuron rigidum* (= *Solidago rigida*), *Liatris punctata*, *Lespedeza capitata*, *Viola pedatifida*, *Coreopsis grandiflora*, *Danthonia spicata*, *Helianthus grosseserratus*, *Mentzelia oligosperma*, *Rudbeckia missouriensis*, *Silene regia*, *Croton willdenowii*, and *Tradescantia bracteata*. In areas of deeper soils, *Baptisia alba* var. *macrophylla*, *Liatris pycnostachya*, and *Vernonia missurica* can also occur within their ranges. Significant areas of this system remain within the Grand Prairie of Texas (Elliott 2011).

Dynamics: Fire and grazing are the prevalent dynamic processes in examples of this system. Overgrazing can lead to soil erosion and invasion of cool-season grasses. Fire suppression can lead to increased cover of woody species.

SOURCES

References: Barbour and Billings 1988, Comer et al. 2003, Elliott 2011, Eyre 1980, Lauver et al. 1999, Ricketts et al. 1999

Version: 17 Feb 2011

Stakeholders: Midwest, Southeast

Concept Author: S. Menard and K. Kindscher, mod. M. Pyne and T. Foti

LeadResp: Midwest

2.B.2.Nc. Eastern North American Grassland, Meadow & Shrubland

M505. NORTHERN NON-ALKALINE SCRUB - HERB ROCK OUTCROP & BARRENS

G058. North-Central Appalachian & Laurentian Acidic Rocky Outcrop

CES201.019 LAURENTIAN ACIDIC ROCKY OUTCROP

Primary Division: Laurentian-Acadian (201)

Land Cover Class: Steppe/Savanna

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Lowland; Ridge/Summit/Upper Slope; Rock Outcrops/Barrens/Glades; Glaciated; Acidic Soil

Concept Summary: This Laurentian and near-boreal outcrop system is found across central southern Canada and the upper Midwest of the United States. It is found on ridges or summits of resistant acidic bedrock at low to mid elevations. The vegetation is patchy, often a mosaic of woodlands and open glades. The system is typically dominated by various conifers, including *Pinus banksiana* and *Picea mariana*, with occasional *Picea glauca* or *Populus tremuloides*. Hardwoods include *Quercus rubra*, *Quercus ellipsoidal*, and *Populus tremuloides*. Structure can vary from treed to low heath shrubs to open lichen woodland. Exposure and occasional fire are the major factors in keeping the vegetation relatively open.

Comments: See also Northern Appalachian-Acadian Rocky Heath Outcrop (CES201.571), which occurs to the east of this system's primary range and is characterized by granitic bedrock.

DISTRIBUTION

Range: This system is found in central Canada south to the Great Lakes and northern Minnesota, eastward in Canada to Quebec and a small portion of extreme northeastern New York.

Divisions: 103:C, 201:C

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

Nations: CA, US

Subnations: MB, MI, MN, NY, ON, QC, WI

Map Zones: 41:C, 50:C, 51:C, 64:C

USFS Ecomap Regions: 211E:CC, 212Jb:CCC, 212Jc:CCC, 212Jo:CCP, 212K:CC, 212Lb:CCP, 212M:CC, 212Q:CC, 212Sb:CCC, 212Sc:CCP, 212Sn:CCP, 212Sq:CCC, 212Tc:CCC, 212X:CC, 212Ya:CCC

CONCEPT

Associations:

- *Pinus banksiana* - (*Picea mariana*, *Pinus strobus*) / *Vaccinium* spp. Rocky Woodland (CEGL002483, G4?)
- *Corylus cornuta* - *Amelanchier* spp. - *Prunus virginiana* Rocky Shrubland (CEGL005197, GNR)
- *Pinus banksiana* - *Pinus strobus* - (*Quercus rubra*) / *Cladina* spp. Nonvascular Vegetation (CEGL002491, G3G5)
- *Juniperus communis* - (*Quercus rubra*) / *Juniperus horizontalis* - *Arctostaphylos uva-ursi* Shrubland (CEGL005065, G3G4)
- *Quercus ellipsoidalis* - *Quercus macrocarpa* - (*Pinus banksiana*) Rocky Woodland (CEGL005246, GNR)
- (*Pinus strobus*, *Quercus rubra*) / *Danthonia spicata* Acidic Bedrock Wooded Herbaceous Vegetation (CEGL005101, G3G4)
- *Populus tremuloides* - (*Populus grandidentata*) Rocky Woodland (CEGL002487, GNR)
- *Picea glauca* - (*Betula papyrifera*) / *Danthonia spicata* Woodland (CEGL005196, GNR)
- *Danthonia spicata* - *Poa compressa* Granite Herbaceous Vegetation (CEGL005157, GNR)
- *Pinus banksiana* / *Photinia melanocarpa* / *Xanthoparmelia* spp. Woodland (CEGL005045, G4G5)
- Boreal Glaciere Talus Sparse Vegetation (CEGL005243, G2G3)

High-ranked species: *Pyrgus wyandot* (G1G2Q)

SOURCES

References: Comer et al. 2003, Edinger et al. 2002, Eyre 1980

Version: 03 Oct 2007

Concept Author: D. Faber-Langendoen

Stakeholders: Canada, East, Midwest

LeadResp: Midwest

M507. NORTHERN CALCAREOUS SCRUB - HERB VEGETATION

G061. Great Lakes Alvar

CES201.721 GREAT LAKES ALVAR

Primary Division: Laurentian-Acadian (201)

Land Cover Class: Steppe/Savanna

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland

National Mapping Codes: EVT 2409; ESLF 5458; ESP 1409

Concept Summary: Alvars are natural systems of humid and subhumid climates, centered around areas of glaciated horizontal limestone/dolomite (dolostone) bedrock pavement with a discontinuous thin soil mantle. These communities are characterized by distinctive flora and fauna with less than 60% tree cover that is maintained by associated geologic, hydrologic, and other landscape processes. In particular, all forms of alvar tend to flood each spring, then experience moderate to severe drought in summer months. They include open pavement, grassland, and shrubland/woodland types. Alvar communities occur in an ecological matrix with similar bedrock and hydrologically influenced communities. Almost all of North America's alvars occur within the Great Lakes basin, primarily in an arc along the Niagaran Escarpment from northern Lake Michigan across northern Lake Huron and eastern Ontario and northwestern New York state.

DISTRIBUTION

Range: Alvars occur within the Great Lakes basin.

Divisions: 201:C

TNC Ecoregions: 48:C, 64:C

Nations: CA, US

Subnations: MI, NY, OH, ON, WI

Map Zones: 41:C, 50:C, 51:C, 52:C, 63:P, 64:C

USFS Ecomap Regions: 211Ee:CCC, 212Hl:CCC, 212Rc:CCC, 212Re:CCC, 212Tb:CCC, 212Te:CCC, 222Ie:CCC, 222U:CC

CONCEPT

Associations:

- *Deschampsia caespitosa* - (*Sporobolus heterolepis*, *Schizachyrium scoparium*) - *Carex crawei* - *Packera paupercula* Herbaceous Vegetation (CEGL005110, G2)
- *Danthonia spicata* - *Poa compressa* - (*Schizachyrium scoparium*) Herbaceous Vegetation (CEGL005100, G2?)
- *Sporobolus heterolepis* - *Schizachyrium scoparium* - (*Carex scirpoidea*) / (*Juniperus horizontalis*) Herbaceous Vegetation (CEGL005234, G2)
- *Sporobolus neglectus* - *Sporobolus vaginiflorus* - *Isanthus brachiatus* - *Panicum philadelphicum* - (*Poa compressa*) Alvar Herbaceous Vegetation (CEGL005235, G2)
- *Juniperus communis* - (*Juniperus virginiana*) - *Rhus aromatica* - *Viburnum rafinesquianum* / *Oligoneuron album* Shrubland (CEGL005212, G3)
- *Juniperus horizontalis* - *Dasiphora fruticosa* ssp. *floribunda* / *Schizachyrium scoparium* - *Carex richardsonii* Dwarf-shrubland (CEGL005236, G2)
- *Carya ovata* / *Zanthoxylum americanum* / *Panicum philadelphicum* - *Carex pensylvanica* Wooded Herbaceous Vegetation (CEGL005230, GNR)
- *Thuja occidentalis* - *Pinus banksiana* / *Dasiphora fruticosa* ssp. *floribunda* / *Clinopodium arkansanum* Wooded Herbaceous Vegetation (CEGL005132, G1G2)
- *Tortella tortuosa* - *Cladonia pocillum* - *Placynthium* spp. Sparse Vegetation (CEGL005192, G2)
- *Juniperus virginiana* / *Ranunculus fascicularis* Woodland (CEGL005122, G3?)
- *Acer saccharum* - *Ostrya virginiana* - *Carya ovata* - *Quercus rubra* Limestone Woodland (CEGL005059, G3G4)
- *Pinus banksiana* - *Thuja occidentalis* - *Picea glauca* / *Juniperus communis* Woodland (CEGL005126, G2?)
- *Picea glauca* - *Thuja occidentalis* - *Juniperus communis* / *Iris lacustris* - *Carex eburnea* Shrubland (CEGL005211, G1G2)

High-ranked species: *Catinella exile* (G2), *Erynnis martialis* (G3), *Iris lacustris* (G3), *Pyrgus wyandot* (G1G2Q), *Sistrurus catenatus* (G3G4)

SOURCES

References: Albert 1990, Comer et al. 2003, Eyre 1980, Reschke et al. 1998

Version: 20 Aug 2007

Concept Author: C. Reschke

Stakeholders: Canada, East, Midwest

LeadResp: Midwest

M508. CENTRAL NON-ACIDIC SCRUB - HERB GLADE, BARRENS & PATCH PRAIRIE

G179. Central Alkaline Glade & Barrens

CES202.602 CENTRAL APPALACHIAN ALKALINE GLADE AND WOODLAND

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Steppe/Savanna

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Woody-Herbaceous; Ridge/Summit/Upper Slope; Unglaciaded; Alkaline Soil; Shallow Soil

National Mapping Codes: EVT 2400; ESLF 5416; ESP 1400

Concept Summary: This system occurs at low to moderate elevations from the Central Appalachians (with a few northward incursions into southernmost New York and New England possible) down into the Ridge and Valley. It consists of woodlands and open glades on thin soils over limestone, dolostone or similar calcareous rock. In some cases, the woodlands grade into closed-canopy forests. *Juniperus virginiana* is a common tree, filling in in the absence of fire, and *Quercus muehlenbergii* is indicative of the limestone substrate. *Rhus aromatica*, *Cercis canadensis*, and *Ostrya virginiana* may occur. Prairie grasses are the dominant herbs (*Andropogon gerardii*, *Schizachyrium scoparium*, *Bouteloua* spp.); forb richness is often high. Characteristic forbs include *Asclepias verticillata*, *Monarda fistulosa*, *Salvia lyrata*, *Symphytotrichum oblongifolium*, and *Brickellia eupatorioides* (Braun 1950). Fire is sometimes an important natural disturbance factor, but open physiognomies may also be maintained by drought and landslides.

DISTRIBUTION

Range: This system is known from Pennsylvania and northwestern New Jersey south through the Ridge and Valley to western Virginia, possibly extending to southeasternmost New York and the marble valleys of northwestern Connecticut.

Divisions: 202:C

TNC Ecoregions: 49:P, 51:C, 59:C, 61:C

Nations: US

Subnations: CT?, MD, NJ, NY?, OH, PA, VA, WV

Map Zones: 57:C, 60:C, 61:C, 64:C, 65:P

USFS Ecomap Regions: 221B:CC, 221D:CC, M221A:CC, M221B:CC

CONCEPT

Associations:

- *Quercus muehlenbergii* - *Cercis canadensis* / *Packera obovata* - *Lithospermum canescens* Woodland (CEGL006231, G3G4)
- *Quercus muehlenbergii* - *Quercus (alba, rubra)* - *Carya cordiformis* / *Viburnum prunifolium* Forest (CEGL004793, G3G4)
- *Quercus rubra* - *Carya (glabra, ovata)* / *Ostrya virginiana* / *Carex lucorum* Forest (CEGL006301, G4)
- *Acer saccharum* - *Quercus muehlenbergii* / *Cercis canadensis* Forest (CEGL006017, G4?)
- *Juniperus virginiana* / *Bouteloua curtipendula* - *Carex eburnea* Wooded Herbaceous Vegetation (CEGL006047, G1G2)
- *Quercus muehlenbergii* / *Packera plattensis* - *Parthenium auriculatum* - *Schizachyrium scoparium* Woodland (CEGL006030, G2)

High-ranked species: *Canis rufus* (G1Q), *Castilleja kraliana* (G2), *Clematis coactilis* (G3), *Delphinium exaltatum* (G3), *Echinacea laevigata* (G2G3), *Melanoplus divergens* (G2G3), *Monarda fistulosa* ssp. *brevis* (G5T1T2), *Puma concolor* cougar (G5THQ), *Rhynchospora thornei* (G3), *Taenidia montana* (G3), *Thaspium pinnatifidum* (G2G3), *Virginia valeriae pulchra* (G5T3T4)

Environment: This system occupies mid-elevation rocky ridges, slopes, and outcrops with thin soils and calcareous bedrock. Large amounts of exposed mineral soils and/or gravel are characteristic. Soils are high in pH and rich in calcium and magnesium. Although these areas are subject to prolonged droughts, local areas of ephemeral vernal seepage occur in microtopographic concavities, and they may have distinctive vegetation (e.g., colonies of *Dodecatheon meadia*). A series of glades in western Virginia is somewhat distinctive because of the dolostone, which contains a high magnesium content. These glades are located on low dolomite knobs and foothills of Elbrook dolomite that occupy middle to upper slopes and crests of south- or southwest-facing spur ridges at relatively low elevations.

Vegetation: In some cases, the woodlands grade into closed-canopy forests. *Juniperus virginiana* is a common tree, filling in in the absence of fire, and *Quercus muehlenbergii* is indicative of the limestone substrate. *Rhus aromatica*, *Cercis canadensis*, and *Ostrya virginiana* may occur. Prairie grasses are the dominant herbs (*Andropogon gerardii*, *Schizachyrium scoparium*, *Bouteloua* spp.); forb richness is often high. Characteristic forbs include *Asclepias verticillata*, *Monarda fistulosa*, *Salvia lyrata*, *Symphotrichum oblongifolium*, and *Brickellia eupatorioides* (Braun 1950).

Dynamics: Fire is an important natural disturbance factor.

SOURCES

References: Braun 1950, Comer et al. 2003, Eyre 1980

Version: 05 May 2008

Concept Author: S.C. Gawler, G. Fleming, R. Evans

Stakeholders: East, Midwest, Southeast

LeadResp: East

CES202.691 CENTRAL INTERIOR HIGHLANDS CALCAREOUS GLADE AND BARRENS

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Steppe/Savanna

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Woody-Herbaceous; Rock Outcrops/Barrens/Glades; Alkaline Soil

National Mapping Codes: EVT 2401; ESLF 5417; ESP 1401

Concept Summary: This system is found primarily in the Interior Highlands of the Ozark, Ouachita, and Interior Low Plateau regions with scattered occurrences in northern Missouri. It occurs along moderate to steep slopes and steep valleys on primarily southerly to westerly facing slopes. Limestone and/or dolomite bedrock typify this system with shallow, moderately to well-drained soils interspersed with rocks. These soils often dry out during the summer and autumn, and then become saturated during the winter and spring. *Schizachyrium scoparium* dominates this system and is commonly associated with *Andropogon gerardii*, *Bouteloua curtipendula*, and calcium-loving plant species. Stunted woodlands primarily dominated by *Quercus muehlenbergii* interspersed with *Juniperus virginiana* occur on variable-depth-to-bedrock soils. Fire is the primary natural dynamic, and prescribed fires help manage this system by restricting woody growth and maintaining the more open glade structure.

Comments: In Alabama, this system is found in the Moulton Valley region, which is technically part of TNC Ecoregion 50, but ambiguously placed there. This region is included in the Interior Plateau (71) of EPA (2004). The system is also found in the Western Valley of the Tennessee River (a very limited part of EPA 71f) in Decatur County, Tennessee. Also included here, somewhat uncomfortably, is an unusual series of flatrock glades on Silurian dolomite in Bullitt County, Kentucky (71d of Woods et al. (2002)).

DISTRIBUTION

Range: This system is found primarily in the Interior Highlands of the Ozark, Ouachita, and the Interior Low Plateau regions ranging east to southern Ohio and including the Knobs region and Cliff section of Kentucky, the Cumberland Plateau escarpment of Tennessee, the Western Valley of the Tennessee River, and the Moulton Valley of northern Alabama.

Divisions: 202:C, 203:C

TNC Ecoregions: 36:C, 38:C, 39:C, 43:C, 44:C, 50:C

Nations: US

Subnations: AL, AR, IL, IN, KY, MO, OH, OK, TN

Map Zones: 43:P, 44:C, 47:C, 48:C, 49:C, 53:C

USFS Ecomap Regions: 221E:CC, 221H:CC, 223B:CC, 223D:CC, 223E:CC, 223F:CC

CONCEPT

Associations:

- *Juniperus ashei* Dry Chalk Outcrop Woodland (CEGL007967, G1)
- *Sporobolus vaginiflorus* var. *ozarkanus* Ozark Herbaceous Vegetation (CEGL008563, G3?)
- *Juniperus virginiana* Alkaline Bluff Woodland (CEGL002426, G3)
- *Rhus aromatica* - *Celtis tenuifolia* / *Carex eburnea* Shrubland (CEGL004393, G3)
- *Fraxinus quadrangulata* - *Juniperus virginiana* var. *virginiana* / *Schizachyrium scoparium* - *Lithospermum canescens* Woodland (CEGL007994, G2)
- (*Quercus stellata*, *Ulmus alata*) / *Schizachyrium scoparium* - *Symphotrichum patens* var. *patentissimum* Wooded Herbaceous Vegetation (CEGL007824, G2?)
- *Juniperus virginiana* var. *virginiana* - *Fraxinus quadrangulata* / *Symphotrichum oblongifolium* - *Panicum flexile* - *Sedum pulchellum* Woodland (CEGL004271, G2)
- *Quercus marilandica* - (*Juniperus virginiana*) / *Schizachyrium scoparium* - *Danthonia spicata* Wooded Herbaceous Vegetation (CEGL002428, G2)
- *Quercus muehlenbergii* - *Fraxinus (quadrangulata, americana)* / *Schizachyrium scoparium* Woodland (CEGL002143, G3G4)
- *Schizachyrium scoparium* - *Sorghastrum nutans* - *Tradescantia bracteata* Alkaline Bedrock Herbaceous Vegetation (CEGL005280, G1G2)
- *Sedum pulchellum* - *Talinum calycinum* - *Oenothera linifolia* Shale Herbaceous Vegetation (CEGL004347, G2G3)
- *Quercus stellata* - *Quercus alba* - (*Quercus falcata*) / *Schizachyrium scoparium* Woodland (CEGL004217, G1)
- *Eleocharis (bifida, compressa)* - *Nothoscordum bivalve* Herbaceous Vegetation (CEGL004669, G3Q)
- *Schizachyrium scoparium* - *Sporobolus compositus* var. *compositus* - *Rudbeckia fulgida* var. *fulgida* Wooded Herbaceous Vegetation (CEGL004078, G2)
- *Juniperus virginiana* / *Schizachyrium scoparium* - *Silphium terebinthinaceum* var. *luciae-brauniae* - *Carex juniperorum* - *Castilleja coccinea* Wooded Herbaceous Vegetation (CEGL004464, G1Q)
- *Sporobolus (neglectus, vaginiflorus)* - *Leavenworthia exigua* var. *laciniata* - *Viola egglestonii* Herbaceous Vegetation (CEGL007772, G1Q)
- *Juniperus ashei* / *Cotinus obovatus* / *Carex eburnea* - *Rudbeckia missouriensis* Woodland (CEGL007833, G2?)
- *Quercus muehlenbergii* - *Juniperus virginiana* / *Schizachyrium scoparium* - *Manfreda virginica* Wooded Herbaceous Vegetation (CEGL005131, G2G3)
- *Juniperus virginiana* / *Schizachyrium scoparium* - (*Andropogon gerardii*, *Sorghastrum nutans*) - *Silphium (trifoliatum, terebinthinaceum)* Wooded Herbaceous Vegetation (CEGL004738, G2)
- *Quercus muehlenbergii* / *Schizachyrium scoparium* - *Bouteloua curtipendula* Wooded Herbaceous Vegetation (CEGL005284, G2G3)
- *Juniperus ashei* Ozark Clifftop Woodland (CEGL004672, G2?)
- *Schizachyrium scoparium* - *Sorghastrum nutans* - *Bouteloua curtipendula* - *Rudbeckia missouriensis* - *Hedyotis nigricans* Wooded Herbaceous Vegetation (CEGL002398, G3G4)
- *Schizachyrium scoparium* - *Bouteloua curtipendula* - *Rudbeckia missouriensis* - *Mentzelia oligosperma* Wooded Herbaceous Vegetation (CEGL002251, G2)
- *Sedum pulchellum* - *Talinum calcaricum* - *Leavenworthia* spp. / *Nostoc commune* Herbaceous Vegetation (CEGL004346, G3)

High-ranked species: *Arabis georgiana* (G1), *Astragalus tennesseensis* (G3), *Canis rufus* (G1Q), *Clematis addisonii* (G1?), *Delphinium alabamicum* (G2), *Delphinium treleasei* (G3), *Echinacea paradoxa* var. *paradoxa* (G2T2), *Leavenworthia alabamica* var. *alabamica* (G2T2Q), *Leavenworthia crassa* (G2), *Leavenworthia exigua* var. *laciniata* (G4T1T2), *Lesquerella densipila* (G3), *Lesquerella filiformis* (G3), *Melanoplus divergens* (G2G3), *Onosmodium decipiens* (G2), *Puma concolor cougar* (G5THQ), *Scutellaria bushii* (G3), *Silphium glutinosum* (G2), *Talinum calcaricum* (G3), *Thaspium pinnatifidum* (G2G3), *Valerianella nuttallii* (G2?), *Virginia valeriae pulchra* (G5T3T4)

Environment: This system is found primarily along moderate to steep slopes and steep valleys on primarily southerly to westerly facing slopes. Limestone and/or dolomite bedrock typify this system with shallow, moderately to well-drained soils interspersed with rocks. Soils are affected by the bedrock chemistry and tend to have high levels of calcium and potassium and a relatively high pH. Due to seasonal rainfall patterns and the extremely thin soils, these soils dry out during the summer and autumn and become saturated during the winter and spring. In northern Alabama (Moulton Valley), the stratum on which the system is found is a type of "marl." Seeps may occur where impervious rock strata meet relatively permeable limestone.

Vegetation: *Schizachyrium scoparium* dominates this system and is commonly associated with *Andropogon gerardii*, *Bouteloua curtipendula*, and calcium-loving plant species. Stunted woodlands primarily dominated by *Quercus muehlenbergii* interspersed with *Juniperus virginiana* occur on variable-depth-to-bedrock soils. The trees typically occur as islands in a wider herbaceous or rocky area. The islands are found in microenvironments where the soil depth and available water are sufficient to support trees (e.g., depressions in the bedrock). Other woody plants associated with this system (within their ranges) include *Quercus shumardii*, *Cercis canadensis*, *Ulmus alata*, *Fraxinus quadrangulata*, *Juniperus ashei*, *Acer saccharum*, and *Frangula caroliniana*. Other herbaceous taxa include *Silphium trifoliatum*, *Silphium terebinthinaceum*, *Liatris* spp., *Symphotrichum oblongifolium*, *Castilleja coccinea*, *Hedyotis nigricans*, *Talinum* spp., *Sedum* spp., and *Panicum flexile*. Small-scale stands of annual *Sporobolus* spp. may be prominent in

some examples. In some examples, small-scale seepage areas may contain *Eleocharis compressa*, *Nothoscordum bivalve*, *Isoetes butleri*, and *Hypoxis hirsuta*.

Dynamics: Fire is the primary natural dynamic and prescribed fires help manage this system by restricting woody growth and maintaining the more open glade structure.

SOURCES

References: Comer et al. 2003, DeSelm and Murdock 1993, Delcourt and Delcourt 1997, EPA 2004, Erickson et al. 1942, Evans 1991, Eyre 1980, Nelson 1985, USFWS 1974, Webb et al. 1997, Woods et al. 2002

Version: 22 May 2008

Stakeholders: Midwest, Southeast

Concept Author: S. Menard, T. Nigh, M. Pyne

LeadResp: Midwest

M509. CENTRAL ACIDIC SCRUB - HERB GLADE & BARRENS

G178. Central Acidic Open Glade & Barrens

CES202.692 CENTRAL INTERIOR HIGHLANDS DRY ACIDIC GLADE AND BARRENS

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Forest and Woodland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

National Mapping Codes: EVT 2363; ESLF 4305; ESP 1363

Concept Summary: This system is primarily found in the Interior Highlands of the Ozark, Ouachita, and Interior Low Plateau regions with small occurrences in northern Missouri. It occurs on flatrock outcrops and along moderate to steep slopes or valley walls of rivers along most aspects. Parent material includes chert, igneous and/or sandstone bedrock with well- to excessively well-drained, shallow soils interspersed with rock and boulders. These soils are typically dry during the summer and autumn, becoming saturated during the spring and winter. Grasses such as *Schizachyrium scoparium* and *Sorghastrum nutans* dominate this system with stunted oak species (*Quercus stellata*, *Quercus marilandica*) and shrub species such as *Vaccinium* spp. occurring on variable depth soils. *Juniperus virginiana* can be present and often increases in the absence of fire. In Kentucky, this system includes both sandstone glades found in the Shawnee Hills (EPA Ecoregions 71a, 72h of Woods et al. (2002)), as well as shale glades found in the Knobs region (EPA Ecoregions 70d, 71c of Woods et al. (2002)), both in the Kentucky Interior Low Plateau. It also includes dry *Quercus stellata*-dominated barrens on Cretaceous-aged gravel substrates on the northern fringes of the Upper East Gulf Coastal Plain Ecoregion in southern Illinois and western Kentucky. This system is influenced by drought and infrequent to occasional fires. Prescribed fires help manage this system by maintaining an open glade structure.

Comments: The occurrence of this system in TNC Ecoregion 43 is apparently confined to southern Illinois and/or Kentucky but does not include any portions of states to the south. Not all examples are acidic. Sometimes a layer of limestone or neutral shale occurs in these and thus are not acidic.

DISTRIBUTION

Range: This system is found in the Interior Highlands of the Ozark, Ouachita, and Interior Low Plateau regions, with rare and limited occurrences in the Upper East Gulf Coastal Plain of Kentucky and Illinois.

Divisions: 202:C, 203:C

TNC Ecoregions: 36:C, 38:C, 39:C, 43:C, 44:C

Nations: US

Subnations: AR, IL, IN, KY, MO, OK, TN?

Map Zones: 43:P, 44:C, 47:C, 48:C, 49:C, 53:C

USFS Ecomap Regions: 221E:CC, 223A:CC, 223B:CC, 223D:CC, 223G:CC, 231H:CC, 251C:CC

CONCEPT

Associations:

- *Schizachyrium scoparium* - *Sorghastrum nutans* - *Coreopsis lanceolata* - *Croton willdenowii* Wooded Herbaceous Vegetation (CEGL002243, G4?)
- *Schizachyrium scoparium* - *Sorghastrum nutans* - *Danthonia spicata* - *Silene regia* Chert Herbaceous Vegetation (CEGL002211, G3)
- *Quercus stellata* - *Quercus marilandica* / *Schizachyrium scoparium* - *Silphium terebinthinaceum* Wooded Herbaceous Vegetation (CEGL005134, G1)
- *Schizachyrium scoparium* - *Sorghastrum nutans* - *Andropogon ternarius* - *Coreopsis grandiflora* Sandstone - Shale Herbaceous Vegetation (CEGL002212, G3)
- *Quercus stellata* - *Quercus marilandica* - *Quercus velutina* - *Carya texana* / *Schizachyrium scoparium* Woodland (CEGL002149, G2G3)
- *Schizachyrium scoparium* - *Aristida dichotoma* - *Croton willdenowii* / Lichens Wooded Herbaceous Vegetation (CEGL002242, G3)

- *Quercus prinus* / *Danthonia spicata* - *Silene caroliniana* Woodland (CEGL004439, G2?)
- (*Quercus stellata*, *Ulmus alata*) / *Schizachyrium scoparium* - *Symphotrichum patens* var. *patentissimum* Wooded Herbaceous Vegetation (CEGL007824, G2?)
- *Schizachyrium scoparium* - *Sedum nuttallianum* - *Selaginella rupestris* - *Portulaca pilosa* / Lichens Wooded Herbaceous Vegetation (CEGL002244, G1G2)
- *Quercus marilandica* - *Juniperus virginiana* var. *virginiana* / *Schizachyrium scoparium* - *Hypericum gentianoides* Wooded Herbaceous Vegetation (CEGL004062, G3?)
- *Asplenium montanum* - *Heuchera parviflora* var. *parviflora* - *Silene rotundifolia* Sparse Vegetation (CEGL004392, G3G4)
- *Quercus marilandica* / *Vaccinium arboreum* / *Danthonia spicata* Scrub Woodland (CEGL002425, G3G4)
- *Quercus prinus* / *Cornus florida* - *Amelanchier arborea* / *Pityopsis graminifolia* var. *latifolia* Woodland (CEGL003706, G2?)
- *Pinus virginiana* - *Pinus (rigida, echinata)* - (*Quercus prinus*) / *Vaccinium pallidum* Forest (CEGL007119, G3)
- *Quercus falcata* - *Quercus (coccinea, stellata)* / *Schizachyrium scoparium* Woodland (CEGL004214, GNA)
- *Quercus stellata* - *Quercus marilandica* / *Schizachyrium scoparium* Wooded Herbaceous Vegetation (CEGL002391, G2G3)
- *Quercus stellata* - (*Pinus echinata*) / *Vaccinium arboreum* / *Andropogon gerardii* - *Symphotrichum patens* var. *patentissimum* Wooded Herbaceous Vegetation (CEGL007814, G2?)

High-ranked species: *Silene regia* (G3)

Environment: This system occurs on flat outcrops of sandstone rock and along moderate to steep slopes or valley walls of rivers along most aspects. Parent material includes chert, shale, igneous and/or sandstone bedrock with well- to excessively well-drained, shallow soils interspersed with rock and boulders. These soils are typically dry during the summer and autumn, becoming saturated during the spring and winter.

Vegetation: Grasses such as *Schizachyrium scoparium* and *Sorghastrum nutans* dominate this system with stunted oak species (*Quercus stellata*, *Quercus marilandica*) and shrub species such as *Vaccinium* spp. occurring on variable depth soils. In the Shawnee Hills (EPA Ecoregions 71a, 72h of Woods et al. (2002)) of the Kentucky Interior Low Plateau, *Quercus marilandica*, *Quercus stellata*, and *Juniperus virginiana* are the dominant trees. *Ulmus alata* may be an understory component. Scattered shrubs, such as *Vaccinium arboreum* and *Chionanthus virginicus*, occur on the margins in patches of deeper soil. *Quercus prinus* may be present in the eastern part of the range. Some other plants that may be associated with these glades include *Andropogon ternarius*, *Danthonia spicata*, *Symphotrichum patens* var. *patentissimum*, *Silene rotundifolia*, *Pityopsis graminifolia* var. *latifolia*, *Coreopsis grandiflora*, *Silene regia*, *Coreopsis lanceolata*, *Croton willdenowii*, *Sedum nuttallianum*, *Selaginella rupestris*, and *Portulaca pilosa*.

Dynamics: This system is influenced by drought and infrequent to occasional fires. Prescribed fires help manage this system by maintaining an open glade structure.

SOURCES

References: Comer et al. 2003, Evans 1991, Eyre 1980, Heikens and Robertson 1995, Nelson 1985, Woods et al. 2002

Version: 22 May 2008

Stakeholders: Midwest, Southeast

Concept Author: S. Menard and T. Nigh

LeadResp: Midwest

CES202.699 NORTH-CENTRAL INTERIOR QUARTZITE GLADE

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Steppe/Savanna

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Concept Summary: This quartzite woodland is found on rocky, hilly regions in the upper midwestern United States in the Baraboo Hills of Wisconsin. Stands occur on the brow of steep slopes that overlay quartzite, rhyolite or sandstone bedrock that contains some fractures. Soils are thin (10-30 cm deep) silt loams, acidic (pH of 4.5-5.0), fertile, and rich in organic matter (10-15% organic matter). These glades represent forest openings dominated by relatively even-spaced, small-statured trees and a sparse shrub and sapling layer. The tree canopy is fairly closed, although historically it may have been more open. These glades are dominated by *Quercus alba* or *Carya ovata* with an understory of herbaceous species such as *Carex pensylvanica*, *Antennaria plantaginifolia*, *Solidago ulmifolia*, and others. Drought strongly influences this system, although deer browsing and fire, at least historically, may also play a role in keeping the glade structure.

Comments: This system was originally included with the Minnesota/South Dakota quartzite glades, but further discussion determined that those examples found within the Driftless Area are distinct from those farther west.

DISTRIBUTION

Range: This system is found in a very restricted area on quartzite, rhyolite or sandstone outcrops in the Baraboo Hills region of Wisconsin.

Divisions: 202:C

TNC Ecoregions: 46:C

Nations: US

Subnations: WI

Map Zones: 42:C, 50:C

CONCEPT

Associations:

- *Quercus alba* - *Carya ovata* / *Carex pensylvanica* - *Heuchera richardsonii* Quartzite Glade Woodland (CEGL005276, G2?)

Environment: Stands occur on the brow of steep slopes that overlay quartzite, rhyolite or sandstone bedrock that contains some fractures. Exposed bedrock may average about 15%. The stands themselves have gentle slopes (2-11%), mostly with a southwestern aspect, but range from due east to due west. Glade soils are thin (10-30 cm deep) silt loams, acidic (pH of 4.5-5.0), fertile, and rich in organic matter (10-15% organic matter). The high organic matter content could be a function of low pH and droughtiness that inhibit decomposition of organic matter (West and Welsh 1998).

Vegetation: These glades represent forest openings dominated by relatively even-spaced, small-statured trees and a sparse shrub and sapling layer. The tree canopy is fairly closed, averaging about 75% (range of 57-82%). Either *Quercus alba* or *Carya ovata* dominate the canopy. *Quercus velutina* and *Quercus rubra* are much less common. Shrubs are nearly absent from all glades. Herbaceous species include *Carex pensylvanica*, *Antennaria plantaginifolia*, *Solidago ulmifolia*, and others. The flora is complicated by the fact that the glades likely served as refugia for prairie plants historically and now serve as refugia for woodland and savanna plants (P. West pers. comm. 2000).

Dynamics: Droughts and deer browse may currently interact to keep these glades open. Historically, the surrounding matrix of dry oak forests may have been more likely to burn, and those fires and the more open canopy could have spread into the glades (West and Welsh 1998). These glades are thought to be more environmentally controlled, by shallow soils, which suggest that soil depth and the historic extent of the glade community may be positively correlated (P. West pers. comm. 2000). *Juniperus virginiana* was present on some of the glades but in small numbers (P. West pers. comm. 2000).

SOURCES

References: Comer et al. 2003, West and Welsh 1998

Version: 11 Apr 2007

Concept Author: S. Menard and D. Faber-Langendoen

Stakeholders: Midwest

LeadResp: Midwest

2.B.4. TEMPERATE & BOREAL SCRUB & HERB COASTAL VEGETATION

2.B.4.Na. Eastern North American Dune & Coastal Grassland & Shrubland

M057. EASTERN NORTH AMERICAN COASTAL DUNE GRASSLAND & SHRUBLAND

G089. Great Lakes Dune Grassland & Shrubland

CES201.026 GREAT LAKES DUNE

Primary Division: Laurentian-Acadian (201)

Land Cover Class: Barren

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland

Concept Summary: This system occurs along the Great Lakes shores region of the United States and Canada. 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. Many open dunes on Lake Michigan are considered "perched dunes" in that sands were deposited on top of glacial moraine located along the coast. In some instances, dunefields sit several hundred feet above current lake levels. Depositional areas, where Great Lakes beachgrass foredunes are found, are dominated by *Ammophila breviligulata* (or in the eastern part of the range *Ammophila champlainensis*); erosional areas, such as slacks in blowouts and dunefields, by *Calamovilfa longifolia*; and stabilized areas by *Schizachyrium scoparium*. In dunefields and on the most stable dune ridges, especially around northern Lake Michigan and Lake Huron, low evergreen shrubs (*Arctostaphylos uva-ursi*, *Juniperus communis*, *Juniperus horizontalis*) occupy dune crests and also the ground layer in the savanna edge of dunes; elsewhere, deciduous shrubs are dominant, including *Prunus pumila*, *Salix cordata*, and *Salix myricoides* (= *Salix glaucophylloides*). Backdunes tend to succeed to forests and savanna indistinguishable from corresponding types found on sandy substrates further inland.

Comments: The system, as described, includes the open grassland, shrubland, and woodland parts of the dune. The lee side of the dunes often contains forests on deep, moist to dry sands that resemble other forested systems. Such forests may include hemlock-hardwood and red oak forests.

DISTRIBUTION

Range: This system 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.

Divisions: 201:C, 202:C

TNC Ecoregions: 48:C, 64:C

Nations: CA, US

Subnations: IL, IN, MI, MN, NY, OH, ON, VT, WI

Map Zones: 41:C, 49:C, 50:C, 51:C, 52:C, 62:C, 63:C, 64:C, 65:C, 66:C

USFS Ecomap Regions: 211E:CC, 212Ha:CCC, 212Hf:CCC, 212Hl:CCC, 212Ra:CCC, 212Rd:CCC, 212Re:CCC, 212Sb:CCC, 212Sn:CCC, 212Te:CCC, 212Ya:CCC, 222Ja:CCC

CONCEPT

Associations:

- *Cakile edentula* Great Lakes Shore Sparse Vegetation (CEGL005162, G3?)
- *Prunus pumila* - (*Ptelea trifoliata*) Dune Shrubland (CEGL005075, G2Q)
- *Cakile edentula* var. *lacustris* - *Argentina anserina* Sparse Vegetation (CEGL006235, GNR)
- *Pinus banksiana* - *Pinus resinosa* - *Pinus strobus* Dune Forest (CEGL002589, G3Q)
- *Ammophila breviligulata* - (*Schizachyrium scoparium*) Herbaceous Vegetation (CEGL005098, G3G5)
- *Populus deltoides* - (*Juniperus virginiana*) Dune Woodland (CEGL005119, G1G2)
- *Juniperus horizontalis* - *Arctostaphylos uva-ursi* - *Juniperus communis* Dune Dwarf-shrubland (CEGL005064, G3G4)

High-ranked species: *Ammophila champlainensis* (G2G3Q), *Botrychium acuminatum* (G1), *Botrychium* sp. 3 (G3), *Copablepharon michiganensis* (G1G2), *Trimerotropis huroniana* (G2G3)

SOURCES

References: Albert 1995b, Chapman et al. 1989, Comer et al. 1995a, Comer et al. 1998, Comer et al. 2003, Dorr and Eschman 1970, Dorroh 1971, Eyre 1980

Version: 25 Mar 2003

Concept Author: D. Faber-Langendoen

Stakeholders: Canada, East, Midwest

LeadResp: Midwest

CES201.726 GREAT LAKES WOODED DUNE AND SWALE

Primary Division: Laurentian-Acadian (201)

Land Cover Class: Mixed Upland and Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland

Diagnostic Classifiers: Forest and Woodland (Treed); Dune (Substrate); Glaciated; Sand Soil Texture; 30-180-day hydroperiod; Coastal Dune Mosaic

National Mapping Codes: EVT 2466; ESLF 9135; ESP 1466

Concept Summary: This system is found in nearly 100 occurrences throughout the Great Lakes shorelines of the United States and Canada. It consists of a foredune, followed by a series of low to high dunes (uplands) and swales (wetlands). The system is often best developed where post-glacial streams entered an embayment and provide a dependable sand source. The combination of along-shore currents, waves, and winds form foredunes along the shoreline. The foredunes of most dune-and-swale complexes are commonly 1-2 m high, with *Ammophila breviligulata*, *Calamovilfa longifolia*, *Salix serissima*, *Salix cordata*, and *Populus balsamifera* most common. The swale immediately behind the foredune is influenced by short-term variation in lake levels and can be partially or occasionally completely filled by dune sands following major storm events. Species common to this first swale include *Juncus balticus*, *Juncus pelocarpus*, *Juncus nodosus*, *Eleocharis acicularis*, and *Schoenoplectus americanus* (= *Scirpus americanus*). Occasionally, such swales may contain lake-influenced, calcareous sands and may contain moderately alkaline indicators.

A low dune field with more advanced plant succession often follows the first open dunes and swales. *Pinus banksiana*, *Pinus strobus*, and *Pinus resinosa* often form a scattered overstory canopy, while *Juniperus communis*, *Juniperus horizontalis*, *Arctostaphylos uva-ursi*, and *Koeleria macrantha* form a scattered ground layer. Following the dune-field zone, both dunes and swales are typically forested. Moist swales are often forested, and soil organic material has often begun to accumulate. *Thuja occidentalis*, *Alnus incana*, *Salix* spp., and *Acer rubrum* dominate the partial overstory canopy and understory. In contrast to the dry or moist swales, wetter swales (where standing water is present through most of the year) may be dominated by Carices, such as *Carex aquatilis* and *Carex stricta*. Forested beach ridges, with soils of medium to coarse sand, tend to be dominated by species common to dry-mesic and mesic northern forest. Complexes located in embayments protected from prevailing winds tend to be formed entirely of low, water-lain beach ridges. As a result, even the beach ridges within these complexes support wetland vegetation.

Six major subtypes of Great Lakes Dune and Swale were described for Michigan, including the Lake Superior high dune type, the Lake Superior low dune type, the North Lake Michigan high dune type, Northern Lake Huron-Lake Michigan low dune type, the Southern Lake Huron type, and the Northern Great Lakes low dune type. These subtypes represent patterns of floristic variation resulting from latitude and sand dune/beach ridge characteristics that constrain floristic and structural attributes. High dune types may support predominantly upland vegetation, while low dune types may support predominantly wetland vegetation.

Comments: Six major subtypes of Great Lakes Dune and Swale were described for Michigan, including the Lake Superior high dune type, the Lake Superior low dune type, the North Lake Michigan high dune type, Northern Lake Huron-Lake Michigan low dune type,

the Southern Lake Huron type, and the Northern Great Lakes low dune type. These subtypes represent patterns of floristic variation resulting from latitude and sand dune/beach ridge characteristics that constrain floristic and structural attributes.

This system has rather strong variation between northern and southern Great Lakes examples (north and south of Bailey's 210-220 division line). Those occurring along the southern Lake Michigan shoreline of Indiana and Illinois have been altered significantly, but likely reflect a distinct ecological system type with oak woodland and savanna on beach ridges and wet prairie in swales.

DISTRIBUTION

Range: This system occurs throughout the Great Lakes shorelines of the United States and Canada. In Pennsylvania, this is only on Presque Isle.

Divisions: 201:C, 202:C

TNC Ecoregions: 48:C

Nations: CA, US

Subnations: IL, IN, MI, MN, NY, OH?, ON, PA, WI

Map Zones: 41:C, 49:C, 50:C, 51:C, 52:C, 62:C, 63:C, 64:C

USFS Ecomap Regions: 211Ee:PPP, 212Ha:CCC, 212Hf:CCC, 212Hi:CCC, 212J:CC, 212L:CC, 212Ra:CCC, 212Rc:CCC, 212Re:CCC, 212Sb:CCC, 212Sc:CCC, 212Sn:CCC, 212Sq:CCC, 212Te:CCC, 212Ya:CCC, 212Z:CC, 222Ib:CCP, 222Ie:CCC, 222Ud:CCC, 222Ue:CCC

CONCEPT

Associations:

- *Thuja occidentalis* - (*Picea mariana*, *Abies balsamea*) / *Alnus incana* Forest (CEGL002456, G4)
- *Prunus pumila* - (*Ptelea trifoliata*) Dune Shrubland (CEGL005075, G2Q)
- *Chamaedaphne calyculata* - *Myrica gale* / *Carex lasiocarpa* Dwarf-shrubland (CEGL005228, G4G5)
- *Pinus banksiana* - (*Pinus resinosa*) - *Pinus strobus* / *Juniperus horizontalis* Wooded Herbaceous Vegetation (CEGL005125, G2)
- *Pinus banksiana* - *Pinus resinosa* - *Pinus strobus* Dune Forest (CEGL002589, G3Q)
- *Ammophila breviligulata* - (*Schizachyrium scoparium*) Herbaceous Vegetation (CEGL005098, G3G5)
- *Populus deltoides* - (*Juniperus virginiana*) Dune Woodland (CEGL005119, G1G2)
- *Juniperus horizontalis* - *Arctostaphylos uva-ursi* - *Juniperus communis* Dune Dwarf-shrubland (CEGL005064, G3G4)
- *Thuja occidentalis* - *Fraxinus nigra* Forest (CEGL005165, GNR)
- *Dasiphora fruticosa* ssp. *floribunda* / *Cladium mariscoides* - *Juncus balticus* - (*Rhynchospora capillacea*) Herbaceous Vegetation (CEGL005105, G3?)
- *Hudsonia tomentosa* Dune Dwarf-shrubland (CEGL004024, GNR)

High-ranked species: *Botrychium* sp. 3 (G3), *Brychius hungerfordi* (G1), *Charadrius melodus* (G3), *Copablepharon michiganensis* (G1G2), *Iris lacustris* (G3), *Lycopodiella margueritiae* (G1G2), *Lycopodiella subappressa* (G2), *Oligoneuron houghtonii* (G3), *Somatochlora hineana* (G2G3), *Trimerotropis huroniana* (G2G3)

Environment: The system consists of a foredune, followed by a series of low to high dunes (uplands) and swales (wetlands). The system is often best developed where post-glacial streams entered an embayment and provide a dependable sand source. The combination of along-shore currents, waves, and winds form foredunes along the shoreline. With gradual long-term drops in water level, combined with post-glacial uplifting of the earth's crust, these low dunes gradually rise above the direct influence of the lakes, and new foredunes replace them. Over several thousand years, a series of ridges and swales is created. For most complexes, the flow of surface streams and groundwater maintain the wet conditions in the swales. With time, plant succession has proceeded to the point where the beach ridges are now forested while the wet swales are either forested or open wetlands. Along the Lake Superior shoreline, where post-glacial uplift is greatest, many of the complexes consist primarily of dry, forested swales. The dunes and swales differs depending on fetch and the amount of sediment available. The influence of Great Lakes water-level fluctuations is probably limited to the first few swales inland from the shoreline. For most of the complexes, the water occupying the swales comes from streams flowing from the adjacent uplands or from groundwater seepage.

Vegetation: The foredunes of most dune-and-swale complexes are commonly 1-2 m high, with *Ammophila breviligulata*, *Calamovilfa longifolia*, *Salix serissima*, *Salix cordata*, and *Populus balsamifera* most common. The swale immediately behind the foredune is influenced by short-term variation in lake levels and can be partially or occasionally completely filled by dune sands following major storm events. Species common to this first swale include *Juncus balticus*, *Juncus pelocarpus*, *Juncus nodosus*, *Eleocharis acicularis*, and *Schoenoplectus americanus* (= *Scirpus americanus*). Occasionally, such swales may contain lake-influenced, calcareous sands, and the shallow swale may contain moderately alkaline indicators, such as *Cladium mariscoides*, *Myrica gale*, *Dasiphora fruticosa* ssp. *floribunda* (= *Pentaphylloides floribunda*), and others. A low dune field with more advanced plant succession often follows the first open dunes and swales. *Pinus banksiana*, *Pinus strobus*, and *Pinus resinosa* often form a scattered overstory canopy, while *Juniperus communis*, *Juniperus horizontalis*, *Arctostaphylos uva-ursi*, and *Koeleria macrantha* form a scattered ground layer. Following the dune-field zone, both dunes and swales are typically forested. Moist swales are often forested, and soil organic material has often begun to accumulate. *Thuja occidentalis*, *Alnus incana*, *Salix* spp., and *Acer rubrum* dominate the partial overstory canopy and understory. In contrast to the dry or moist swales, wetter swales (where standing water is present through most of the year) may be dominated by Carices, such as *Carex aquatilis* and *Carex stricta*. Forested beach ridges, with soils of medium to coarse sand, tend to be dominated by species common to dry-mesic and mesic northern forest. Soil moisture

conditions appear to change dramatically with slight elevational changes and are reflected in the development of soil organic material and changing plant species. On higher, drier ridges, soils often have less than 3 cm of organic material. *Pinus resinosa*, *Pinus strobus*, and *Quercus rubra* are often codominant, while *Betula papyrifera*, *Populus grandidentata*, *Abies balsamea*, and *Acer rubrum* are subdominant or understory species. *Pteridium aquilinum*, *Gaylussacia baccata*, *Vaccinium myrtilloides*, *Cornus canadensis*, and *Gaultheria procumbens* occur in the shrub and ground layers. Complexes located in embayments protected from prevailing winds tend to be formed entirely of low, water-lain beach ridges. As a result, even the beach ridges within these complexes support wetland vegetation.

Dynamics: Foredune and immediate back dune areas are influenced by active dune processes of wind-caused "blowouts" and subsequent restabilization. Forested beach ridges may support fire regimes characteristic of similar upland forest systems outside of these complexes. Due to lakeshore proximity, heavy winds and resultant windthrow are common in forested ridges. Great Lakes water-level fluctuations likely influence water levels in swales closest to the shoreline, if at all. The hydrology of interdunal swales is driven largely by lateral flow through the porous beach ridges. Older swales (farthest from current lakeshores) in larger complexes support peat-forming bogs.

SOURCES

References: Comer and Albert 1993, Comer et al. 2003, Eyre 1980, Lichter 1998, MNFI 1999

Version: 11 Apr 2007

Stakeholders: Canada, East, Midwest

Concept Author: P. Comer and D. Albert

LeadResp: Midwest

G764. Great Lakes Sand Beach

CES201.149 GREAT LAKES SAND BEACH

Primary Division: Laurentian-Acadian (201)

Land Cover Class: Barren

Spatial Scale & Pattern: Linear

Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland

Concept Summary: This ecological system is found along the shores of the Great Lakes, particularly along Lake Michigan. It is found on sandy substrates with little or no soil development within a few meters elevation of the water. The sandy substrate is not stabilized by significant vegetation and is easily moved. Stands of this system are subject to frequent disturbance by wind, waves, and ice-scour. Stands are typically narrow and linear but may extend for miles along the lakeshore. Vegetation is absent to sparse; that which is present is short and dominated by herbaceous species. *Ammophila breviligulata* and *Cakile edentula* are among the most common species. *Chamaesyce polygonifolia*, *Juncus balticus*, *Lathyrus japonicus*, and *Argentina anserina* (= *Potentilla anserina*) can be found, as well.

Comments: There may be small dunes within this system, but areas where dunes are more extensive should be placed within Great Lakes Dune (CES201.026) or Great Lakes Wooded Dune and Swale (CES201.726). Cobble beaches are not included in this system but are in Great Lakes Acidic Rocky Shore and Cliff (CES201.025) or Great Lakes Alkaline Rocky Shore and Cliff (CES201.095), as appropriate.

DISTRIBUTION

Range: This system is found along the margins of the Great Lakes. It is most common along Lake Michigan but is also found on the south shore of Lake Superior and in places on Lake Huron, Lake Erie, and Lake Ontario.

Divisions: 201:C, 202:C

TNC Ecoregions: 48:C

Nations: CA, US

Subnations: IN, MI, NY?, OH?, ON, PA?, WI

Map Zones: 41:C, 51:C, 59:P, 62:?

USFS Ecomap Regions: 212Ha:CCC, 212Hf:CCC, 212Hl:CCP, 212Ra:CCP, 212Rc:CCP, 212Ya:CCC, 212Zc:CPP, 222Ia:C??, 222Ja:CCC, 222Kg:CCC, 222Ua:CCP, 222Uc:CCP, 222Ud:CCP, 222Ue:CCP

CONCEPT

Associations:

- *Ammophila breviligulata* - (*Schizachyrium scoparium*) Herbaceous Vegetation (CEGL005098, G3G5)
- *Cakile edentula* Great Lakes Shore Sparse Vegetation (CEGL005162, G3?)
- *Cakile edentula* var. *lacustris* - *Argentina anserina* Sparse Vegetation (CEGL006235, GNR)

Environment: This system is found on sandy substrates with little or no soil development within a few meters elevation of the water. It rarely extends more than 30-50 m from the water. The sandy substrate is not stabilized by significant vegetation and is easily moved. Stands are subject to frequent disturbance by wind, waves, and ice-scour.

Vegetation: Vegetation is absent to sparse; that which is present is short and dominated by herbaceous species. *Ammophila breviligulata* and *Cakile edentula* are common. *Chamaesyce polygonifolia*, *Juncus balticus*, *Lathyrus japonicus*, and *Argentina anserina* (= *Potentilla anserina*) can be found, as well.

Dynamics: Stands are subject to frequent disturbance by wind, waves (with storm surges), and ice-scour. This leads to erosion or deposition of the sandy substrate by wind or water. The disturbances keep the beaches nearly free of vegetation.

SOURCES

References: Midwestern Ecology Working Group n.d.

Version: 19 Dec 2012

Concept Author: J. Drake

Stakeholders: Canada, East, Midwest

LeadResp: Midwest

M176. EASTERN NORTH AMERICAN LAKE & RIVER SHORELINE VEGETATION

G342. Eastern North American Lake Shoreline & Beach

CES201.586 LAURENTIAN-ACADIAN LAKESHORE BEACH

Primary Division: Laurentian-Acadian (201)

Land Cover Class: Barren

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland; Wetland

Diagnostic Classifiers: Depressional; Flood Scouring; Broad-Leaved Shrub; Dwarf-Shrub; Graminoid; Short (<5 yrs) Flooding Interval [Short interval, Irregular Flooding]

Concept Summary: This system encompasses primarily upland vegetation along lakeshores or rivershores in the glaciated Northeast and upper Midwest (not including the Great Lakes). Some areas may be briefly inundated during high water periods. The substrate is sandy to gravelly, sometimes consolidated rock; there may be muddy patches. Ice-scour is not a major influence, although it may be locally important. These shores may be narrow zones of shrubs and/or sparse vegetation on rocks or sandy beaches. Descriptions of these beaches from Maine, New Hampshire, Vermont, and Minnesota suggests a variable structure and composition influenced by exposure, substrate, and how wet the substrate remains. The upper zone often features shrubs; these may include *Myrica gale*, *Gaylussacia baccata*, *Salix* spp., and *Photinia melanocarpa* (= *Aronia melanocarpa*). Creeping shrubs such as *Hudsonia* spp., *Juniperus horizontalis*, and *Prunus pumila* var. *susquehanae* may be locally important. The herbaceous flora likewise varies; *Schizachyrium scoparium*, *Dichanthelium clandestinum*, *Cyperus* spp., *Dulichium arundinaceum*, and *Spartina pectinata* are representative graminoids; forbs may include *Argentina anserina*, *Lechea intermedia*, *Scutellaria lateriflora*, and *Mimulus ringens*, among others.

Comments: Very little data on these. May not be defensible as a separate system, keep in for now as a placeholder. If it is combined with the surrounding uplands, the associations tagged to this system may become orphans.

DISTRIBUTION

Range: Northern New England and northern New York west across the upper Great Lakes to northern Minnesota, and adjacent Canada; occasional southwards.

Divisions: 201:C

TNC Ecoregions: 47:C, 48:C, 60:C, 61:C, 63:C, 64:C

Nations: US

Subnations: MA, ME, MI, MN, NH, NY, RI, VT, WI

Map Zones: 41:C, 50:C, 51:C, 63:C, 64:C, 66:C

USFS Ecomap Regions: 211A:CP, 211B:CP, 211C:CP, 211D:CP, 211F:CC, 212Tb:CCC, 221:C

CONCEPT

Associations:

- *Spartina pectinata* North Atlantic Coast Herbaceous Vegetation (CEGL006095, GNR)
 - Lake Mudflats Sparse Vegetation (CEGL002313, GNR)
 - *Hudsonia tomentosa* - *Lupinus perennis* Dwarf-shrubland (CEGL006233, G1)
 - Inland Freshwater Strand Beach Sparse Vegetation (CEGL002310, G4G5)
 - Eroding Clay Bank Sparse Vegetation (CEGL002584, GNR)
 - *Dasiphora fruticosa* ssp. *floribunda* / *Rhynchospora capillacea* - *Scleria verticillata* Shrub Herbaceous Vegetation (CEGL006356, G1)
 - Igneous - Metamorphic Cobble - Gravel Inland Lake Shore Sparse Vegetation (CEGL002303, G4G5)
- High-ranked species:** *Oxytropis campestris* var. *chartacea* (G5T1T2), *Williamsonia lintneri* (G3)

SOURCES

References: Comer et al. 2003, Gawler and Cutko 2010

Version: 25 Feb 2010

Concept Author: S.C. Gawler

Stakeholders: East, Midwest

LeadResp: East

G753. Appalachian & Interior Riverscours Barrens & Prairie**CES202.703 OZARK-OUACHITA RIPARIAN****Primary Division:** Central Interior and Appalachian (202)**Land Cover Class:** Mixed Upland and Wetland**Spatial Scale & Pattern:** Linear**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland**Diagnostic Classifiers:** Ozark/Ouachita

Concept Summary: This system is found along streams and small rivers within the Ozark and Ouachita regions. In contrast to larger floodplain systems, this system has little to no floodplain development and often contains cobble bars and steep banks. It is traditionally higher gradient than larger floodplains and experiences periodic, strong flooding. It is often characterized by a cobble bar with forest immediately adjacent with little to no marsh development. Canopy cover can vary within examples of this system, but typical tree species include *Liquidambar styraciflua*, *Platanus occidentalis*, *Betula nigra*, *Acer* spp., and *Quercus* spp. The richness of the herbaceous layer can vary significantly, ranging from species-rich to species-poor. Likewise, the shrub layer can vary considerably, but typical species may include *Lindera benzoin*, *Alnus serrulata*, and *Hamamelis vernalis*. Small seeps and fens can often be found within this system, especially at the headwaters and terraces of streams. These areas are typically dominated by primarily wetland obligate species of sedges (*Carex* spp.), ferns (*Osmunda* spp.), and other herbaceous species such as *Impatiens capensis*. Flooding and scouring strongly influence this system and prevent the floodplain development found on larger rivers.

Comments: A separate Ozark-Ouachita fen/seep system (CES202.052) has also been developed.**DISTRIBUTION****Range:** This system is found within the Ozarks and the Ouachita Mountains of Missouri, Arkansas and Oklahoma.**Divisions:** 202:C**TNC Ecoregions:** 38:C, 39:C**Nations:** US**Subnations:** AR, MO, OK**Map Zones:** 32:C, 44:C**USFS Ecomap Regions:** M223A:CC, M231A:CC**CONCEPT****Associations:**

- *Carex crinita* - *Osmunda* spp. / *Physocarpus opulifolius* Seep Herbaceous Vegetation (CEGL002392, G2)
- *Justicia americana* Herbaceous Vegetation (CEGL004286, G4G5)
- *Zizaniopsis miliacea* Rocky Riverbed Herbaceous Vegetation (CEGL004140, G2?)
- *Podostemum ceratophyllum* Herbaceous Vegetation (CEGL004331, G3G5)
- *Juniperus virginiana* var. *virginiana* - *Leptopus phyllanthoides* - (*Quercus nigra*, *Ilex vomitoria*) Shrubland (CEGL003942, G2Q)
- *Salix nigra* Temporarily Flooded Shrubland (CEGL003901, G4?)
- *Liquidambar styraciflua* - (*Quercus alba*, *Acer saccharum*) / *Carpinus caroliniana* / *Lindera benzoin* Forest (CEGL007826, G3G4)
- (*Carex interior*, *Carex lurida*) - *Carex leptalea* - *Parnassia grandifolia* - *Rhynchospora capillacea* Herbaceous Vegetation (CEGL002404, G2G3)
- *Taxodium distichum* - *Platanus occidentalis* Ouachita Foothills Forest (CEGL007377, G2Q)
- *Betula nigra* - *Platanus occidentalis* Forest (CEGL002086, G5)
- *Carex crinita* - *Osmunda* spp. / *Sphagnum* spp. Herbaceous Vegetation (CEGL002263, G2G3)
- *Acer (saccharum, barbatum)* - *Quercus rubra* - *Carya cordiformis* / *Asimina triloba* Forest (CEGL002060, G3)
- *Carex interior* - *Carex lurida* - *Andropogon gerardii* - *Parnassia grandifolia* Herbaceous Vegetation (CEGL002416, G1G2)
- *Hamamelis vernalis* - *Cornus obliqua* - *Hypericum prolificum* Shrubland (CEGL003898, G3)
- *Alnus serrulata* - *Amorpha fruticosa* Shrubland (CEGL007807, G3?)
- *Panicum virgatum* - *Calamovilfa arcuata* Herbaceous Vegetation (CEGL007838, G2?)
- *Scirpus cyperinus* Seasonally Flooded Southern Herbaceous Vegetation (CEGL003866, G4)
- *Alnus serrulata* Interior Shrubland (CEGL003894, G4?)
- *Juncus effusus* Seasonally Flooded Herbaceous Vegetation (CEGL004112, G5)
- *Pontederia cordata* - *Peltandra virginica* Semipermanently Flooded Herbaceous Vegetation [Placeholder] (CEGL004291, GNR)
- *Acer negundo* - (*Platanus occidentalis*, *Populus deltoides*) Forest (CEGL004690, G4)
- Ozark Riverine Cobble - Gravel Flats Sparse Vegetation (CEGL007012, GNR)
- *Salix caroliniana* Temporarily Flooded Ozark Shrubland (CEGL007064, G4?)
- *Carex jorii* - *Eleocharis tenuis* var. *verrucosa* - *Juncus* spp. - *Panicum rigidulum* Interior Highlands Channel Scar Depression Wooded Herbaceous Vegetation (CEGL007116, G2?)

High-ranked species: *Amblyscirtes linda* (G2G3), *Amorpha ouachitensis* (G3Q), *Amsonia hubrichtii* (G3), *Calamovilfa arcuata* (G2G3), *Carex latebracteata* (G3), *Heuchera villosa* var. *arkansana* (G5T3Q), *Hydrophyllum brownei* (G2), *Ptilimnium nodosum* (G2), *Saxifraga palmeri* (G3Q)

Environment: This system has little to no floodplain development and often contains cobble bars and steep banks. It is often characterized by a cobble bar with forest immediately adjacent with little to no marsh development.

Vegetation: Typical tree species in examples of this system include *Liquidambar styraciflua*, *Platanus occidentalis*, *Betula nigra*, maples (*Acer* spp.), and oaks (*Quercus* spp.). The richness of the herbaceous layer can vary significantly, ranging from species-rich to species-poor. Likewise, the shrub layer can vary considerably, but typical species may include *Lindera benzoin*, *Alnus serrulata*, and *Hamamelis vernalis*.

Dynamics: Flooding and scouring strongly influence this system and prevent the floodplain development found on larger rivers. It is traditionally higher gradient than larger floodplains and experiences periodic, strong flooding.

SOURCES

References: Comer et al. 2003, Eyre 1980, Nelson 1985

Version: 26 Jan 2006

Concept Author: S. Menard

Stakeholders: Midwest, Southeast

LeadResp: Midwest

2.B.5. TEMPERATE & BOREAL BOG & FEN

2.B.5.Na. North American Bog & Fen

M061. APPALACHIAN, INTERIOR PLATEAU & PRAIRIE FEN

G182. Interior Plateau Seepage Fen

CES202.346 INTERIOR LOW PLATEAU SEEPAGE FEN

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland

Diagnostic Classifiers: Seepage-Fed Sloping

Concept Summary: This system accommodates small-scale, herbaceous-dominated seepage areas found in limited areas of the Interior Low Plateau of Tennessee, Kentucky and possibly Ohio. It is most frequent in the Western Highland Rim of Tennessee (Lewis, Cheatham, and Williamson counties). There are also rare occurrences of this system in the Eastern Highland Rim of Tennessee and related limited areas of Kentucky and possibly Ohio (D. Minney pers. comm. 2006). These features have been generally known as "seepage fens" and are fed by mineral-rich groundwater. Examples are associated with stream drainages but are generally not affected by stream-related hydrology. Soils contain a thin organic layer over limestone gravel, over a less permeable layer of more solid rock. The vegetation is dominated by herbaceous plants. Characteristic species include *Carex atlantica*, *Carex lurida*, *Carex leptalea* ssp. *harperi*, *Parnassia grandifolia*, *Juncus brachycephalus*, *Rudbeckia fulgida* var. *umbrosa*, *Cardamine bulbosa*, *Impatiens capensis*, *Juncus coriaceous*, *Juncus effusus*, *Lobelia puberula*, *Lobelia cardinalis*, *Oxypolis rigidior*, *Phlox glaberrima*, *Rhynchospora capitellata*, *Scirpus atrovirens*, *Scirpus cyperinus*, *Solidago patula* var. *patula*, and *Thelypteris palustris* var. *pubescens*. Woody species include *Alnus serrulata*, *Salix humilis*, *Salix caroliniana*, *Cornus amomum*, and *Acer rubrum*, which may invade the herbaceous seep. *Xyris tennesseensis* is endemic to this system and occurs in 50% or more of its occurrences.

Comments: This system is a small-patch system, originally described from a small region. Its range has been expanded to include a greater geographic scope.

DISTRIBUTION

Range: This system is found in limited areas of the Interior Low Plateau of Tennessee, Kentucky and possibly Ohio, including primarily the Western Highland Rim region of Tennessee (Ecoregion 71f of Griffith et al. (1998), EPA (2004); Subsection 222Eg of Keys et al. (1995)).

Divisions: 202:C

TNC Ecoregions: 44:C

Nations: US

Subnations: KY, OH?, TN

Map Zones: 47:C, 48:C, 53:C

CONCEPT

Associations:

- *Carex lurida* - *Carex leptalea* - *Parnassia grandifolia* - *Juncus brachycephalus* - (*Xyris tennesseensis*) Herbaceous Vegetation (CEGL004161, G1)
- *Alnus serrulata* Saturated Southern Interior Shrubland (CEGL007059, G3)

High-ranked species: *Parnassia grandifolia* (G3), *Xyris tennesseensis* (G2)

Environment: These features are fed by mineral-rich groundwater. Stands occur on the sideslopes of hills in narrow valleys, bases of bluffs, rock ledges, and terraces of streams and rivers, where the soil or substrate is saturated by calcareous groundwater seepage. Examples are associated with stream drainages but are generally not affected by stream-related hydrology. The parent material is a mixture of gravel and dolomite with fragments of deeply weathered bedrock present or colluvium over bedrock. Soils contain a thin organic layer over limestone gravel, over a less permeable layer of more solid rock.

Vegetation: The vegetation is dominated by herbaceous plants. Characteristic species include *Carex atlantica*, *Carex lurida*, *Carex leptalea* ssp. *harperi*, *Parnassia grandifolia*, *Juncus brachycephalus*, *Rudbeckia fulgida* var. *umbrosa*, *Cardamine bulbosa*, *Impatiens capensis*, *Juncus coriaceous*, *Juncus effusus*, *Lobelia puberula*, *Lobelia cardinalis*, *Oxypolis rigidior*, *Phlox glaberrima*, *Rhynchospora capitellata*, *Scirpus atrovirens*, *Scirpus cyperinus*, *Solidago patula* var. *patula*, and *Thelypteris palustris* var. *pubescens*. Woody species include *Alnus serrulata*, *Salix humilis*, *Salix caroliniana*, *Cornus amomum*, and *Acer rubrum*. Some stands in southern Ohio may lack *Parnassia* (D. Minney pers. comm. 2006).

SOURCES

References: Comer et al. 2003, EPA 2004, Evans 1991, Griffith et al. 1998, Keys et al. 1995, Minney 2000, Minney pers. comm.

Version: 17 Apr 2006

Stakeholders: Midwest, Southeast

Concept Author: M. Pyne

LeadResp: Southeast

CES202.052 OZARK-OUACHITA FEN

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland

Diagnostic Classifiers: Herbaceous; Seepage-Fed Sloping; Circumneutral Soil; Aquic; Ozark/Ouachita

Concept Summary: This fen system is found in the Ozarks region of the United States. Stands occur on the sideslopes of hills in narrow valleys, bases of bluffs, rock ledges, and terraces of streams and rivers, where the soil or substrate is saturated by calcareous groundwater seepage. Soils are moist to wet, mucky peat or mineral, with pH above 6.5, and vary from shallow (0-40 cm) to moderately deep (40-100 cm), depending on natural disturbance and slope. The parent material is a mixture of gravel and dolomite with fragments of deeply weathered bedrock present, or colluvium over bedrock. The bedrock strata are exposed, especially in hanging fens where the slope is greater than 35 degrees. Hydrophytic plants dominate the fen, which varies from mixed grass or sedge fen with complex zonation to more tallgrass prairie species mixed with calciphiles. Fires are possible in some of the larger prairie fens.

Comments: Some fens are typically associated with riparian vegetation. Seeps in the Ozarks are typically acidic to circumneutral and differ substantially in floristics and groundwater chemistry from these alkaline fens.

DISTRIBUTION

Range: This fen community type is found in the Ozarks region of the United States.

Divisions: 202:C

TNC Ecoregions: 38:C

Nations: US

Subnations: AR, MO

Map Zones: 44:C

CONCEPT

Associations:

- (*Carex interior*, *Carex lurida*) - *Carex leptalea* - *Parnassia grandifolia* - *Rhynchospora capillacea* Herbaceous Vegetation (CEGL002404, G2G3)

- *Carex interior* - *Carex lurida* - *Andropogon gerardii* - *Parnassia grandifolia* Herbaceous Vegetation (CEGL002416, G1G2)

High-ranked species: *Calephelis muticum* (G3), *Parnassia grandifolia* (G3)

Vegetation: Stands of this small-scale system are typically dominated by primarily wetland obligate species of sedges (*Carex* spp.), ferns (*Osmunda* spp.), and other herbaceous species such as *Impatiens capensis* and *Parnassia grandifolia*.

SOURCES

References: Comer et al. 2003, Nelson 1985, Orzell et al. 1985

Version: 17 Jan 2006

Stakeholders: Midwest, Southeast

Concept Author: D. Faber-Langendoen

LeadResp: Midwest

G183. North-Central Appalachian, Interior & Prairie Fen

CES202.702 NORTH-CENTRAL INTERIOR SHRUB-GRAMINOID ALKALINE FEN

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland

Concept Summary: This fen system is found in the glaciated portions of the Midwest and southern Canada. Examples of this system can be located on level to sloping seepage areas, in pitted outwash or in kettle lakes associated with kettle-kame-moraine topography. Groundwater flows through marls and shallow peat soils, and groundwater is typically minerotrophic and slightly alkaline. Examples of this system contain a core fen area of graminoids surrounded by shrubs with a fairly continuous sphagnum moss layer. Herbaceous and shrub cover is variable with little to no tree cover. Characteristic species include prairie grasses such as *Andropogon gerardii* and *Spartina pectinata* with prairie forbs and sedges (*Carex* spp.). Common shrub species include *Dasiphora fruticosa* ssp. *floribunda*, *Cornus* spp., and *Salix* spp. Alterations in wetland hydrology and agricultural development can threaten examples of this system.

DISTRIBUTION

Range: This system is found in the northern Midwest and southern Canada.

Divisions: 201:C, 202:C

TNC Ecoregions: 35:C, 36:C, 45:C, 46:C, 47:C, 48:C, 49:P

Nations: CA, US

Subnations: IA, IL, IN, MI, MN, ND, OH, ON, PA, SD, WI

Map Zones: 39:C, 40:C, 41:C, 42:C, 43:C, 49:C, 50:C, 51:C, 52:C, 62:P

USFS Ecomap Regions: 221F:CC, 222H:CC, 222Ja:CCC, 222Jb:CCC, 222Jc:CCC, 222Je:CCC, 222Jf:CCP, 222Jg:CCC, 222Jh:CCC, 222Ji:CCC, 222K:CC, 222M:CC, 222U:CP, 251B:CC

CONCEPT

Associations:

- *Cladium mariscoides* - (*Carex lasiocarpa*, *Hypericum kalmianum*, *Oligoneuron riddellii*, *Eleocharis elliptica*) Herbaceous Vegetation (CEGL005104, G2?)
- *Vaccinium corymbosum* - *Gaylussacia baccata* - *Photinia melanocarpa* / *Calla palustris* Shrubland (CEGL005085, G2G3)
- *Carex lasiocarpa* - *Carex oligosperma* / *Sphagnum* spp. Herbaceous Vegetation (CEGL002265, G3G4)
- *Dasiphora fruticosa* ssp. *floribunda* / *Carex interior* - *Carex flava* - *Sarracenia purpurea* Shrub Herbaceous Vegetation (CEGL005140, G3)
- *Dasiphora fruticosa* ssp. *floribunda* / *Carex sterilis* - *Andropogon gerardii* - *Arnoglossum plantagineum* Shrub Herbaceous Vegetation (CEGL005139, G3G4)
- *Cornus racemosa* / *Carex* (*sterilis*, *aquatilis*, *lacustris*) Shrub Herbaceous Vegetation (CEGL006123, G2G3)
- *Cornus* spp. - *Salix* spp. - *Vaccinium corymbosum* - *Rhamnus alnifolia* - *Toxicodendron vernix* Shrubland (CEGL005083, G4?)
- *Cornus amomum* - *Salix* spp. - *Toxicodendron vernix* - *Rhamnus lanceolata* Fen Shrubland (CEGL005087, G2G3)
- *Symplocarpus foetidus* Herbaceous Vegetation (CEGL002385, G4?)
- *Betula pumila* - *Salix* spp. Prairie Fen Shrubland (CEGL002189, G3)
- *Carex lasiocarpa* - *Calamagrostis* spp. - (*Eleocharis rostellata*) Herbaceous Vegetation (CEGL002383, G3G4)
- *Cladium mariscoides* - *Carex cryptolepis* - *Rhynchospora alba* - *Juncus canadensis* Herbaceous Vegetation (CEGL005103, GNRQ)

High-ranked species: *Calephelis muticum* (G3), *Clonophis kirtlandii* (G2), *Hypericum adpressum* (G3), *Oecanthus laricis* (G1G2), *Platanthera leucophaea* (G2G3), *Poa paludigena* (G3), *Valeriana edulis* var. *ciliata* (G5T3)

Environment: Examples of this system can be located on level to sloping seepage areas, in pitted outwash or in kettle lakes associated with kettle-kame-moraine topography. Groundwater flows through marls and shallow peat soils, and groundwater is typically minerotrophic and slightly alkaline.

Vegetation: Examples of this system contain a core fen area of graminoids surrounded by shrubs with a fairly continuous sphagnum moss layer. Herbaceous and shrub cover is variable with little to no tree cover. Characteristic species include prairie grasses such as *Andropogon gerardii* and *Spartina pectinata* with prairie forbs and sedges (*Carex* spp.). Common shrub species include *Dasiphora fruticosa* ssp. *floribunda*, *Cornus* spp., and *Salix* spp.

Dynamics: Alterations in wetland hydrology and agricultural development can threaten examples of this system.

SOURCES

References: Comer et al. 2003, MNNHP 1993

Version: 18 Jul 2006

Concept Author: S. Menard

Stakeholders: Canada, East, Midwest

LeadResp: Midwest

M062. NORTH AMERICAN BOREAL & SUB-BOREAL BOG & FEN

G185. Eastern North American Boreal Alkaline Fen

CES201.585 LAURENTIAN-ACADIAN ALKALINE FEN

Primary Division: Laurentian-Acadian (201)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland

Diagnostic Classifiers: Organic Peat (>40 cm); Mesotrophic Water; Alkaline Water; Circumneutral Water

Concept Summary: These fens, distributed across glaciated eastern and central North America, develop in open basins where bedrock or other substrate influence creates circumneutral to calcareous conditions. They are most abundant in areas of limestone bedrock, and widely scattered in areas where calcareous substrates are scarce. Shore fens, which are peatlands that are occasionally flooded along stream and lakeshores, are also included here because flooding tends to create moderately alkaline conditions. The vegetation may be graminoid-dominated, shrub-dominated, or a patchwork of the two; *Dasiphora fruticosa ssp. floribunda* is a common diagnostic shrub. The herbaceous flora is usually species-rich and includes calciphilic graminoids and forbs. *Sphagnum* dominates the substrate; *Campylium stellatum* is an indicator bryophyte. The edge of the basin may be shallow to deep peat over a sloping substrate, where seepage waters provide nutrients.

Comments: Need to clarify the conceptual boundaries between this and the boreal fens in central and eastern Canada. Alkaline wooded swamps, some of which have fen-like characteristics, are treated under Laurentian-Acadian Alkaline Conifer-Hardwood Swamp (CES201.575).

DISTRIBUTION

Range: Scattered locations from New England and adjacent Canada west to the Great Lakes and northern Minnesota.

Divisions: 201:C, 202:C

TNC Ecoregions: 47:C, 48:C, 60:C, 61:C, 63:C, 64:P

Nations: CA, US

Subnations: MA, ME, MI, MN, NB, NH, NY, PA, VT, WI

Map Zones: 41:C, 50:C, 51:C, 63:C, 64:C, 65:P, 66:C

USFS Ecomap Regions: 211A:CP, 211E:CC, 211F:CP, 211I:CC, 212Ha:CCP, 212Hb:CCP, 212Hc:CCP, 212Hd:CCP, 212He:CCC, 212Hf:CCC, 212Hg:CCC, 212Hh:CCP, 212Hi:CCC, 212Hj:CCP, 212Hk:CCC, 212Hl:CCC, 212Hm:CCP, 212J:CC, 212K:CC, 212L:CC, 212M:CC, 212N:CC, 212Q:CP, 212Ra:CCP, 212Rb:CCC, 212Rc:CCC, 212Rd:CCC, 212Re:CCC, 212S:CC, 212Tb:CCC, 212Te:CCP, 212X:CC, 212Y:CC, 212Z:CC, 221A:CC, 221B:CC, 222I:CC, M211A:CP, M211B:CP, M211C:CC

CONCEPT

Associations:

- *Alnus incana* - *Salix* spp. - *Betula pumila* / *Chamaedaphne calyculata* Shrubland (CEGL005227, GNR)
- *Carex lasiocarpa* - (*Carex rostrata*) - *Equisetum fluviatile* Herbaceous Vegetation (CEGL005229, GNR)
- *Betula pumila* - *Dasiphora fruticosa ssp. floribunda* / *Carex lasiocarpa* - *Trichophorum alpinum* Shrubland (CEGL002495, G3G5)
- *Chamaedaphne calyculata* - *Myrica gale* / *Carex lasiocarpa* Dwarf-shrubland (CEGL005228, G4G5)
- *Betula pumila* / *Chamaedaphne calyculata* / *Carex lasiocarpa* Shrubland (CEGL002494, G4G5)
- *Carex lasiocarpa* - *Calamagrostis* spp. - (*Eleocharis rostellata*) Herbaceous Vegetation (CEGL002383, G3G4)
- *Carex (interior, hystericina, flava)* - *Trichophorum alpinum* / *Campylium stellatum* Shrub Herbaceous Vegetation (CEGL006331, G2G3)
- *Dasiphora fruticosa ssp. floribunda* / *Carex lasiocarpa* / *Campylium stellatum* Shrub Herbaceous Vegetation (CEGL006525, GNR)
- *Dasiphora fruticosa ssp. floribunda* / *Carex (sterilis, hystericina, flava)* Shrub Herbaceous Vegetation (CEGL006326, G2)
- *Thuja occidentalis* - *Abies balsamea* / *Ledum groenlandicum* / *Carex trisperma* Woodland (CEGL006507, GNR)
- *Carex lasiocarpa* - *Carex buxbaumii* - *Trichophorum caespitosum* Boreal Herbaceous Vegetation (CEGL002500, G4G5)
- *Thuja occidentalis* - (*Myrica gale*) / *Trichophorum alpinum* / *Drepanocladus* spp. Shrubland (CEGL005193, GNR)
- *Myrica gale* - *Dasiphora fruticosa ssp. floribunda* / *Carex lasiocarpa* - *Cladium mariscoides* Shrub Herbaceous Vegetation (CEGL006068, G2G3)
- *Carex lasiocarpa* - *Trichophorum caespitosum* - *Rhynchospora capillacea* / *Andromeda polifolia* Herbaceous Vegetation (CEGL002496, G2Q)
- *Prunus virginiana* - *Acer spicatum* - *Ribes triste* / *Angelica atropurpurea* - *Heracleum maximum* Shrubland (CEGL006583, GNR)

High-ranked species: *Calephelis muticum* (G3), *Carex heleonastes* ssp. *heleonastes* (G4T3T4), *Carex schweinitzii* (G3G4), *Catinella exile* (G2), *Glyptemys muhlenbergii* (G3), *Oligoneuron houghtonii* (G3), *Platanthera leucophaea* (G2G3), *Poa paludigena* (G3), *Polemonium occidentale* ssp. *lacustre* (G5?T1Q), *Sarracenia purpurea* ssp. *heterophylla* (G5T1T2Q), *Trigonopeltastes floridana* (G2G3), *Trollius laxus* ssp. *laxus* (G5T3)

SOURCES

References: Comer et al. 2003, Eyre 1980, Gawler and Cutko 2010

Version: 14 Dec 2004

Concept Author: S.C. Gawler

Stakeholders: Canada, East, Midwest

LeadResp: East

G745. Eastern North American Sub-Boreal Acidic Bog & Poor Fen**CES202.606 NORTH-CENTRAL INTERIOR AND APPALACHIAN ACIDIC PEATLAND****Primary Division:** Central Interior and Appalachian (202)**Land Cover Class:** Woody Wetland**Spatial Scale & Pattern:** Small patch**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Wetland**Diagnostic Classifiers:** Shrubland (Shrub-dominated); Organic Peat (>40 cm); Acidic Water; >180-day hydroperiod

Concept Summary: These *Sphagnum* and shrub peatlands occur in basins south of the Laurentian-Acadian region down to near the glacial boundary in the northeastern and north-central U.S. Unlike the true raised bogs of boreal regions, the vegetation is not raised above the groundwater level. They are found in colder regions, mostly in areas where glacial stagnation left coarse deposits and glacial depressions (many are "kettleholes"). The basins are generally closed, i.e., without inlets or outlets of surface water, and typically small in area. The nutrient-poor substrate and the reduced throughflow of water create oligotrophic conditions fostering the development of *Sphagnum* peat and the growth of peatland vegetation. In deeper basins, the vascular vegetation grows on a *Sphagnum* mat over water, with no mineral soil development. Ericaceous shrubs and dwarf-shrubs (e.g., *Chamaedaphne calyculata*) dominate, with patches of graminoid dominance. Some peatlands may have a sparse tree layer. Although these are often called bogs, in most cases they are technically fens (albeit nutrient-poor ones), as the vegetation remains in contact with the groundwater.

Comments: This system occurs south of the Laurentian-Acadian division in the Midwest, south of the Northern Appalachian-Boreal ecoregion in the Northeast, and inland from the Coastal Plain, and these acidic peatlands are distinctive and discrete elements of the landscape. They are related to Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp (CES201.574) and Boreal-Laurentian-Acadian Acidic Basin Fen (CES201.583), but occur in a different landscape setting and often have some more temperate floristic elements to distinguish them. They include treed, shrub, and graminoid associations, often occurring in a mosaic. In the Midwest, it may be necessary to split off the shrub/graminoid acid peatland (poor fen) types.

DISTRIBUTION

Range: This system is found from central New England to the Great Lakes and south-central Minnesota southward, generally associated with the glacial terminus or stagnation zones, and interior from the Coastal Plain.

Divisions: 202:C**TNC Ecoregions:** 45:P, 46:P, 48:P, 49:P, 60:C, 61:C, 64:C**Nations:** CA, US**Subnations:** CT, IL, IN, MA, ME, MI, MN, NH, NJ, NY, OH, ON, PA, RI, VT, WI**Map Zones:** 41:?, 49:P, 50:P, 51:P, 52:P, 61:C, 62:C, 63:C, 64:C, 65:C, 66:P**USFS Ecomap Regions:** 211F:CC, 211I:CP, 211J:CC, 221A:CC, 221B:CC, 221D:CC, 221E:CC, 221Fa:CCC, 222I:CC, 222Ja:CCC, 222Jb:CCC, 222Jc:CCC, 222Je:CCC, 222Jg:CCC, 222Jh:CCC, 222Ji:CCC, 222R:CC, 222Ua:CCP, 222Ud:CCC, 222Ue:CCC**CONCEPT****Associations:**

- *Larix laricina* / *Photinia melanocarpa* / *Sphagnum* spp. Forest (CEGL002472, G4?)
- *Vaccinium corymbosum* - *Gaylussacia baccata* - *Photinia melanocarpa* / *Calla palustris* Shrubland (CEGL005085, G2G3)
- *Pinus rigida* / *Chamaedaphne calyculata* / *Sphagnum* spp. Woodland (CEGL006194, G3G5)
- *Sphagnum (cuspidatum, torreyanum)* - *Vaccinium macrocarpon* Nonvascular Vegetation (CEGL006394, GNR)
- *Myrica gale* - *Chamaedaphne calyculata* / *Carex (lasiocarpa, utriculata)* - *Utricularia* spp. Shrub Herbaceous Vegetation (CEGL006302, G4G5)
- *Vaccinium corymbosum* / *Sphagnum* spp. Shrubland (CEGL006190, G4)
- *Carex lasiocarpa* - *Carex oligosperma* - (*Lysimachia terrestris*) / *Sphagnum* spp. Herbaceous Vegetation (CEGL005279, G3G4)
- *Chamaedaphne calyculata* / *Eriophorum virginicum* / *Sphagnum rubellum* Dwarf-shrubland (CEGL006513, GNR)
- *Pinus rigida* - *Picea rubens* / *Viburnum nudum var. cassinoides* / *Sphagnum* spp. Woodland (CEGL006587, G1G2)
- *Pinus rigida* / *Vaccinium myrtilloides* / *Sphagnum* spp. Woodland (CEGL006022, G1G2)
- *Chamaedaphne calyculata* - (*Gaylussacia dumosa*) - *Decodon verticillatus* / *Woodwardia virginica* Dwarf-shrubland (CEGL006008, G5)
- *Picea mariana* / (*Vaccinium corymbosum*, *Gaylussacia baccata*) / *Sphagnum* sp. Woodland (CEGL006098, G3G5)
- *Carex oligosperma* - *Carex pauciflora* - *Eriophorum vaginatum* / *Sphagnum* spp. Herbaceous Vegetation (CEGL005256, G4G5)
- *Acer rubrum* / *Alnus incana* - *Ilex verticillata* / *Osmunda regalis* Woodland (CEGL006395, GNR)
- *Chamaedaphne calyculata* / *Carex oligosperma* - *Eriophorum virginicum* Dwarf-shrubland (CEGL005092, G3G4)
- *Dulichium arundinaceum* - *Triadenum virginicum* / *Sphagnum fallax* Herbaceous Vegetation (CEGL006077, GNR)
- *Dulichium arundinaceum* / *Sphagnum* spp. Herbaceous Vegetation (CEGL006131, GNR)
- *Sphagnum rubellum* - *Vaccinium oxycoccos* Nonvascular Vegetation (CEGL006135, GNR)

High-ranked species: *Cyzicus gynecia* (G2Q), *Platanthera leucophaea* (G2G3)**SOURCES****References:** Comer et al. 2003, Damman and French 1987, Eyre 1980, Gawler and Cutko 2010

G748. Eastern North American Boreal Acidic Bog & Fen**CES103.581 BOREAL-LAURENTIAN BOG****Primary Division:** Boreal (103)**Land Cover Class:** Woody Wetland**Spatial Scale & Pattern:** Large patch**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Wetland**Diagnostic Classifiers:** Organic Peat (>40 cm); Dwarf-Shrub; Graminoid; Oligotrophic Water

Concept Summary: These raised peatlands are found at the higher temperate and near-boreal latitudes of the northeastern and north-central United States and adjacent Canada, where climate allows the rate of peat accumulation to exceed its decomposition, resulting in acidic peatlands. Most are ombrotrophic, at least over part of their area, though some examples may be weakly minerotrophic (poor fen), especially around the margins. The surface morphology of the bog may be more-or-less level, domed, or eccentric, but typically is over the water table. The vegetation is either semi-treed and dominated by low ericaceous shrubs (including *Kalmia angustifolia*, *Kalmia polifolia*, *Ledum groenlandicum*, and *Chamaedaphne calyculata*), with patches of conifers, graminoids and bryophyte lawns, or more open forest, where trees form a partial to moderate cover over parts of the peatland. In the latter situation, stunted *Picea mariana* and *Larix laricina* are the dominant trees, and dwarf-shrubs (*Chamaedaphne calyculata*, *Ledum groenlandicum*) and sedges are common in the understory.

Secondary bog pools (schlenke) may be present. While the raised portion defines these bogs, fen vegetation is often present along the perimeter.

This broadly defined peatland system can be subdivided based on the geomorphology of the peatland. A variety of approaches have been taken: in Maine, see Davis and Anderson (2001); in Canada, see National Wetlands Working Group (1988); and in Minnesota, see Glaser (1992). In Canada, bog and fen peatlands each have their own set of forms. In Minnesota, Glaser treats bogs and fens together as part of larger patterned peatland complexes (mire complexes).

Comments: This system corresponds to Glaser and Janssens' (1986) forested and "semi-forested continental bogs," but this system is somewhat broader in scope as it includes both the domed bogs and the flat bogs in the system type. Thus it extends further southward, into the central Great Lakes and northeasternmost United States. Eastward, it extends roughly to the Acadian region, where it is replaced by Acadian Maritime Bog (CES201.580). Northwestward in northern Ontario, continental non-forested bogs are common (Glaser and Janssens 1986, fig. 2).

These bogs may overlap in common terminology with that of "muskeg," a flat bog peatland with scattered trees and a fairly dense shrub layer on hummocky peat. But muskeg could include poor fens and acidic swamps as well as bogs.

DISTRIBUTION

Range: This system occurs in central and eastern Canada, extending into northern New England and the Great Lakes region, particularly in northern Minnesota. Very few examples occur south of the Laurentian-Acadian Division.

Divisions: 103:C, 201:C, 202:C**TNC Ecoregions:** 47:C, 48:C, 61:C, 63:C**Nations:** CA, US**Subnations:** MB, ME, MI, MN, NB, NS, NY, ON, PE?, QC, VT, WI**Map Zones:** 41:C, 50:C, 51:C, 64:C, 66:C

USFS Ecomap Regions: 211Aa:CCC, 211Ab:CCC, 211Ba:CCC, 211Bb:CCC, 211Ca:CCC, 211Cb:CCC, 211Da:CCC, 211Dc:CCC, 212Ha:CCC, 212Hb:CCC, 212Hc:CCC, 212Hd:CCC, 212He:CCC, 212Hf:CCC, 212Hg:CCC, 212Hh:CCC, 212Hi:CCC, 212Hj:CCC, 212Hk:CCC, 212Hl:CCC, 212Hm:CCC, 212Ra:CCC, 212Rb:CCC, 212Rc:CCC, 212Rd:CCC, 212Re:CCC, 221Ai:CCP, 221Ak:CCC, M211Aa:CCC, M211Ab:CCC, M211Ae:CCC, M211Af:CCC, M211Ba:CCP, M211Ca:CCP, M211Da:CCP, M211Dc:CCP

CONCEPT**Associations:**

- *Kalmia angustifolia* - *Chamaedaphne calyculata* - (*Picea mariana*) / *Cladina* spp. Dwarf-shrubland (CEGL006225, G5)
- *Carex (oligosperma, exilis)* - *Chamaedaphne calyculata* Shrub Herbaceous Vegetation (CEGL006524, GNR)
- *Carex lasiocarpa* - *Rhynchospora alba* - *Scheuchzeria palustris* Herbaceous Vegetation (CEGL002501, G2?)
- *Sphagnum (cuspidatum, torreyanum)* - *Vaccinium macrocarpon* Nonvascular Vegetation (CEGL006394, GNR)
- *Chamaedaphne calyculata* - *Ledum groenlandicum* - *Kalmia polifolia* Bog Dwarf-shrubland (CEGL005278, G5)
- *Alnus incana ssp. rugosa* - *Nemopanthus mucronatus* / *Sphagnum* spp. Shrubland (CEGL006158, G5)
- *Picea mariana* / *Ledum groenlandicum* / *Carex trisperma* / *Sphagnum* spp. Forest (CEGL002485, G5)

- *Picea mariana* / *Chamaedaphne calyculata* / *Sphagnum* spp. Dwarf-shrubland (CEGL005218, G4G5)
- *Rhododendron canadense* - *Chamaedaphne calyculata* Dwarf-shrubland (CEGL006514, GNR)
- *Picea mariana* / (*Vaccinium corymbosum*, *Gaylussacia baccata*) / *Sphagnum* sp. Woodland (CEGL006098, G3G5)
- *Carex oligosperma* - *Carex pauciflora* - *Eriophorum vaginatum* / *Sphagnum* spp. Herbaceous Vegetation (CEGL005256, G4G5)
- *Carex limosa* - *Rhynchospora alba* / *Sphagnum pulchrum* - *Cladopodiella* sp. Herbaceous Vegetation (CEGL006522, GNR)
- *Picea mariana* - (*Larix laricina*) / *Ledum groenlandicum* / *Sphagnum* spp. Forest (CEGL005271, G5)
- *Chamaedaphne calyculata* / *Carex oligosperma* / *Sphagnum* spp. Poor Fen Dwarf-shrubland (CEGL005277, G5)
- *Sphagnum rubellum* - *Vaccinium oxycoccos* Nonvascular Vegetation (CEGL006135, GNR)

High-ranked species: *Appalachia arcana* (G2G3), *Callophrys lanoraieensis* (G3G4), *Carex heleonastes* ssp. *heleonastes* (G4T3T4), *Sarracenia purpurea* ssp. *heterophylla* (G5T1T2Q), *Somatochlora hineana* (G2G3)

SOURCES

References: Comer et al. 2003, Damman and French 1987, Davis and Anderson 2001, Eyre 1980, Gawler and Cutko 2010, Glaser 1992a, Glaser and Janssens 1986, Harris et al. 1996, Kost et al. 2007, National Wetlands Working Group 1988

Version: 04 Mar 2004

Stakeholders: Canada, East, Midwest

Concept Author: S.C. Gawler and D. Faber-Langendoen

LeadResp: East

CES201.583 BOREAL-LAURENTIAN-ACADIAN ACIDIC BASIN FEN

Primary Division: Laurentian-Acadian (201)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland

Diagnostic Classifiers: Depressional; Organic Peat (>40 cm); Broad-Leaved Shrub; Dwarf-Shrub; Graminoid; *Picea mariana* - *Larix laricina*; Acidic Water

Concept Summary: This peatland system ranges over a broad geographic area across the glaciated Northeast to the Great Lakes and upper Midwest. The fens have developed in open or closed, relatively shallow basins with nutrient-poor and acidic conditions. Many occur in association with larger lakes or streams. Some occur as kettlehole fens (usually called kettlehole "bogs") associated with eskers or other glacial deposits. The substrate is *Sphagnum*, and vegetation typically includes areas of graminoid dominance and dwarf-shrub dominance. *Chamaedaphne calyculata* is usually present and often dominant. Scattered stunted trees may be present. These fens often develop adjacent to open water and may form a floating mat over water.

Particularly distinctive are the ribbed bogs or fens in which a pattern of narrow (2- to 3-m wide), low (less than 1 m deep) ridges are oriented at right angles to the direction of the drainage (National Wetlands Working Group 1988). Wet pools or depressions occur between the ridges. These patterned peatlands may include string bog, Atlantic ribbed fen, or northern ribbed fen (National Wetlands Working Group 1988). They develop almost entirely north of 46 degrees N latitude in east-central Canada and the adjacent U.S. They are minerotrophic peatlands in which the vegetation has developed into a pattern of strings (raised, usually linear features) and flarks (wet depressions separating the strings). The substrate chemistry is entirely acidic in some peatlands; in others, where bedrock or other substrate influence creates circumneutral to calcareous conditions, peatland chemistry may be entirely calcareous or vary from acidic to calcareous within the same peatland. In acidic portions, typical bog heaths predominate mixed with sedges. *Dasiphora fruticosa* ssp. *floribunda* is diagnostic of circumneutral to calcareous conditions. These peatlands usually develop in open basins and flat plains, and the patterned portion may occupy only a fraction of the entire peatland. The edge of the basin may be shallow to deep peat over a sloping substrate, where seepage waters provide nutrients.

Comments: Need to clarify the conceptual boundaries between this and the boreal fens in central and eastern Canada. This system is also similar to acidic peatlands in the southern edge of the glaciated region, which are treated under North-central Interior and Appalachian Acidic Peatland (CES202.606); those often tend to be smaller-patch landscape elements. USFS sections are used to differentiate the ranges.

DISTRIBUTION

Range: This system is found in New England and adjacent Canada west to the Great Lakes and Minnesota, north of the glacial boundary.

Divisions: 103:C, 201:C, 202:C

TNC Ecoregions: 47:C, 48:P, 61:C, 63:C

Nations: CA, US

Subnations: MA, ME, MI, MN, NB?, NH, NS?, NY, QC, VT, WI

Map Zones: 41:C, 50:C, 51:C, 63:P, 64:C, 65:C, 66:C

USFS Ecomap Regions: 211A:CC, 211B:CC, 211C:CC, 211D:CC, 211E:CC, 212Ha:CCP, 212Hb:CCP, 212Hc:CCP, 212Hd:CCP, 212He:CCP, 212Hf:CCC, 212Hg:CCC, 212Hh:CCP, 212Hi:CCP, 212Hj:CCP, 212Hk:CCC, 212Hl:CCP, 212Hm:CCP, 212J:CP, 212Lb:CCP, 212Ra:CCC, 212Rb:CCC, 212Rc:CCP, 212Rd:CCP, 212Re:CCC, 212S:CP, 212T:CP, 212X:CP, 212Ya:CCP, M211A:CC, M211B:CC, M211C:CC, M211D:CC

CONCEPT

Associations:

- *Carex (oligosperma, exilis) - Chamaedaphne calyculata* Shrub Herbaceous Vegetation (CEGL006524, GNR)
 - *Carex lasiocarpa - Carex oligosperma / Sphagnum* spp. Herbaceous Vegetation (CEGL002265, G3G4)
 - *Betula pumila / Chamaedaphne calyculata / Carex lasiocarpa* Shrubland (CEGL002494, G4G5)
 - *Myrica gale - Spiraea alba - Chamaedaphne calyculata* Shrubland (CEGL006512, GNR)
 - *Myrica gale - Chamaedaphne calyculata / Carex (lasiocarpa, utriculata) - Utricularia* spp. Shrub Herbaceous Vegetation (CEGL006302, G4G5)
 - *Vaccinium corymbosum / Sphagnum* spp. Shrubland (CEGL006190, G4)
 - *Larix laricina / Chamaedaphne calyculata / Carex lasiocarpa* Shrubland (CEGL005226, G4G5)
 - *Thuja occidentalis - Abies balsamea / Ledum groenlandicum / Carex trisperma* Woodland (CEGL006507, GNR)
 - *Carex limosa - Rhynchospora alba / Sphagnum pulchrum - Cladopodiella* sp. Herbaceous Vegetation (CEGL006522, GNR)
 - *Acer rubrum / Alnus incana - Ilex verticillata / Osmunda regalis* Woodland (CEGL006395, GNR)
 - *Chamaedaphne calyculata / Carex oligosperma / Sphagnum* spp. Poor Fen Dwarf-shrubland (CEGL005277, G5)
- High-ranked species:** *Appalachia arcana* (G2G3), *Carex heleonastes* ssp. *heleonastes* (G4T3T4), *Lycopodiella margueritiae* (G1G2), *Lycopodiella subappressa* (G2), *Plebejus idas empetri* (G5T3T4), *Sarracenia purpurea* ssp. *heterophylla* (G5T1T2Q)

SOURCES

References: Comer et al. 2003, Damman and French 1987, Eyre 1980, Gawler and Cutko 2010

Version: 05 Jun 2008

Stakeholders: Canada, East, Midwest

Concept Author: S.C. Gawler

LeadResp: East

2.B.6. TEMPERATE & BOREAL FRESHWATER MARSH, WET MEADOW & SHRUBLAND

2.B.6.Na. Eastern North American Freshwater Wet Meadow, Riparian & Marsh

M067. ATLANTIC & GULF COASTAL PLAIN POND SHORE & WET MEADOW

G111. Atlantic & Gulf Coastal Plain Pondshore & Wet Prairie

CES203.518 NORTHERN ATLANTIC COASTAL PLAIN POND

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland

Concept Summary: This system includes vegetation of groundwater-flooded depressions characterized by a flora generally restricted to the Coastal Plain from the southern portion of the Delmarva peninsula to Cape Cod, Massachusetts, and with peripheral occurrences to southern Maine. Ponds may contain permanent water, such as the deep glacial kettleholes of Cape Cod and Long Island, New York, or may be shallow basins where groundwater drops below the surface late in the growing season. This system occurs on sandy deposits such as outwash plains of the glaciated region (Long Island and Cape Cod), on the deep sands of the New Jersey Pine Barrens, or on finer sediments of the Coastal Plain of Cape May, New Jersey, the Delmarva peninsula, and the Chesapeake Bay region. The vegetation of steeper-sided basins (generally those containing permanent water) are characterized by strong zonation, with a border of tall shrubs, such as *Vaccinium corymbosum*, and several essentially concentric bands or zones dominated by different associations, depending on geography. Characteristic species in Massachusetts and Long Island include *Rhexia virginica*, *Cyperus dentatus*, *Gratiola aurea*, *Panicum verrucosum*, *Euthamia caroliniana* (= *Euthamia tenuifolia*), *Carex striata*, *Juncus pelocarpus*, *Rhynchospora capillacea*, *Rhynchospora macrostachya*, *Xyris difformis*, *Fimbristylis autumnalis*, *Scleria reticularis*, *Sabatia kennedyana*, *Drosera filiformis*, *Juncus militaris*, and many others.

Ponds of the New Jersey Pine Barrens share many of these species, with others including *Juncus repens*, *Muhlenbergia torreyi*, *Rhynchospora oligantha*, *Rhynchospora cephalantha*, *Rhynchospora chalarocephala*, and many others. In shallow basins, such strong zonation is generally lacking but still remains evident in some cases. On Cape Cod, Long Island, and New Jersey, this system most often occurs within the pitch pine barrens. From Cape May and south, the system occurs within an upland matrix of mixed hardwood forests and generally supports a seasonally flooded swamp forest characterized by *Liquidambar styraciflua*, *Acer rubrum*, wetland oaks such as *Quercus palustris* and *Quercus phellos*, and in Virginia and scattered locations on the Inner Coastal Plain of Maryland *Nyssa biflora*. The vegetation is characterized by many of the species from New England, New York and New Jersey and also includes *Juncus repens*, *Boltonia asteroides*, *Fimbristylis perpusilla*, *Coelorachis rugosa*, *Dichanthelium spretum*, *Saccharum*

giganteum, *Eleocharis quadrangulata*, and others. *Cephalanthus occidentalis* often occurs as scattered individuals or as a shrub swamp with less diversity and cover of Coastal Plain flora.

Comments: In some cases, these are locally known as "Delmarva bays."

DISTRIBUTION

Range: This system ranges from the southern portion of the Delmarva peninsula to Cape Cod, Massachusetts, with scattered Coastal Plain occurrences north to southern Maine; also in limited, highly disjunct occurrences on sand lakeplain near southern Lake Michigan and in southeastern Vermont.

Divisions: 202:C, 203:C

TNC Ecoregions: 48:C, 58:C, 61:C, 62:C

Nations: US

Subnations: DE, MA, MD, ME, MI, NH, NJ, NY, VA, VT, WI

Map Zones: 49:?, 51:C, 60:C, 63:P, 64:P, 65:C

USFS Ecomap Regions: 212Ha:CCC, 212Hb:CCC, 212T:CC, 221A:CC, 222Ja:CCC, 222Jb:CCC, 222Jg:CCC, 222Jh:CCC, 222R:CC, 232A:CC

CONCEPT

Associations:

- *Fraxinus pennsylvanica* - *Juglans nigra* - *Ulmus americana* / *Cornus amomum* / *Onoclea sensibilis* Forest (CEGL006918, GNR)
- *Vaccinium corymbosum* - *Rhododendron viscosum* - *Clethra alnifolia* Shrubland (CEGL006371, G3)
- *Liquidambar styraciflua* - *Acer rubrum* - *Quercus phellos* / *Leucothoe racemosa* Forest (CEGL006110, G3)
- *Rhexia virginica* - *Panicum verrucosum* Herbaceous Vegetation (CEGL006264, G2G3)
- *Juncus militaris* - *Eriocaulon aquaticum* Herbaceous Vegetation (CEGL006345, GNR)
- *Cladium mariscoides* - *Eleocharis equisetoides* Herbaceous Vegetation (CEGL006016, GNR)
- *Lysimachia terrestris* - *Dulichium arundinaceum* - *Rhexia virginica* Herbaceous Vegetation (CEGL006035, G2G3)
- *Eleocharis flavescens* - *Xyris difformis* Herbaceous Vegetation (CEGL006400, GNR)
- *Spartina pectinata* North Atlantic Coast Herbaceous Vegetation (CEGL006095, GNR)
- *Calamagrostis canadensis* - *Dichanthelium meridionale* - (Mixed Shrub) Herbaceous Vegetation (CEGL006243, GNR)
- *Eleocharis (obtusata, flavescens)* - *Eriocaulon aquaticum* Herbaceous Vegetation (CEGL006261, G3G5)
- *Dulichium arundinaceum* - *Juncus canadensis* - *Juncus pelocarpus* Herbaceous Vegetation (CEGL006415, GNR)
- *Carex striata* var. *brevis* Herbaceous Vegetation (CEGL004120, G3G4)
- *Liquidambar styraciflua* - *Acer rubrum* - *Nyssa biflora* / *Carex jorii* Forest (CEGL006223, G1G2)
- *Populus heterophylla* - *Acer rubrum* - *Quercus palustris* - *Liquidambar styraciflua* Forest (CEGL006469, GNR)
- *Cephalanthus occidentalis* / *Polygonum hydropiperoides* - *Panicum verrucosum* Shrubland (CEGL006242, G3?)
- *Taxodium distichum* - *Nyssa (biflora, sylvatica)* / *Clethra alnifolia* / *Boehmeria cylindrica* Forest (CEGL006214, G2)
- *Polygonum (hydropiperoides, punctatum)* - *Leersia* spp. Herbaceous Vegetation (CEGL004290, G4?)
- *Rhynchospora capitellata* - *Cyperus dentatus* - *Rhexia virginica* - *Xyris difformis* Herbaceous Vegetation (CEGL006210, G2)
- *Rhynchospora capitellata* - *Rhexia virginica* - *Rhynchospora scirpoides* - *Schoenoplectus hallii* Herbaceous Vegetation (CEGL005108, G2?)
- *Cladium mariscoides* - *Coelorachis rugosa* Herbaceous Vegetation (CEGL006332, G1)
- *Leersia hexandra* - (*Panicum verrucosum*, *Scleria reticularis*) Herbaceous Vegetation (CEGL004047, G2G3)
- *Juncus repens* - *Boltonia asteroides* Herbaceous Vegetation (CEGL006610, GNR)
- *Saccharum giganteum* - (*Dichanthelium spretum*, *Panicum verrucosum*) Herbaceous Vegetation (CEGL006609, G1G2)
- *Panicum hemitomon* - *Panicum verrucosum* Herbaceous Vegetation (CEGL006338, GNR)
- *Nymphaea odorata* - *Eleocharis robbinsii* Herbaceous Vegetation (CEGL006086, G2)
- *Rhexia virginica* - *Crotalaria sagittalis* Herbaceous Vegetation (CEGL006300, G2)
- *Eriocaulon aquaticum* - *Lobelia dortmanna* Herbaceous Vegetation (CEGL006346, GNR)
- *Eragrostis hypnoides* - *Ludwigia sphaerocarpa* - *Polygonum hydropiperoides* Herbaceous Vegetation (CEGL006608, GNR)
- *Decodon verticillatus* / *Triadenum virginicum* Shrubland (CEGL006087, GNR)
- *Decodon verticillatus* Semipermanently Flooded Shrubland (CEGL005089, GNR)

High-ranked species: *Clonophis kirtlandii* (G2), *Coreopsis rosea* (G3), *Dichanthelium hirstii* (G1), *Eulimnadia agassizii* (G1G2), *Eupatorium leucolepis* var. *novae-angliae* (G5T1), *Eupatorium resinosum* (G3), *Euthamia galetorum* (G3), *Fimbristylis perpusilla* (G2), *Helenium virginicum* (G3), *Hypericum adpressum* (G3), *Lobelia boykinii* (G2G3), *Lycopodiella margueritiae* (G1G2), *Lycopodiella subappressa* (G2), *Oxypolis canbyi* (G2), *Papaipema sulphurata* (G2), *Rhexia aristosa* (G3G4), *Sabatia kennedyana* (G3), *Sagittaria teres* (G3), *Schoenoplectus etuberculatus* (G3G4), *Scirpus ancistrochaetus* (G3), *Sisyrinchium strictum* (G2Q)

SOURCES

References: Comer et al. 2003, Eastern Ecology Working Group n.d., Gawler and Cutko 2010

Version: 05 May 2008

Stakeholders: East, Midwest, Southeast

Concept Author: SC. Gawler, R. Evans, L. Sneddon, M. Pyne

LeadResp: East

M069. EASTERN NORTH AMERICAN WET MEADOW & MARSH**G112. Eastern North American Wet Meadow****CES201.582 LAURENTIAN-ACADIAN WET MEADOW-SHRUB SWAMP****Primary Division:** Laurentian-Acadian (201)**Land Cover Class:** Herbaceous Wetland**Spatial Scale & Pattern:** Large patch**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Wetland**Diagnostic Classifiers:** Depressional [Lakeshore]; Riverine / Alluvial; Broad-Leaved Shrub; Graminoid; Shallow (<15 cm) Water**Concept Summary:** This system encompasses shrub swamps and wet meadows on mineral soils of the Northeast and upper Midwest. They are often associated with lakes and ponds, but are also found along streams, where the water level does not fluctuate greatly. They are commonly flooded for part of the growing season but often do not have standing water throughout the season. The size of occurrences ranges from small pockets to extensive acreages. The system can have a patchwork of shrub and graminoid dominance; typical species include *Salix* spp., *Cornus amomum*, *Alnus incana*, *Spiraea alba*, *Calamagrostis canadensis*, tall *Carex* spp., and *Juncus effusus*. Trees are generally absent and, if present, are scattered.**Comments:** Compared to North-Central Interior Wet Meadow-Shrub Swamp (CES202.701), this system is more often dominated by *Alnus* spp. rather than the *Cornus* spp. dominance of the latter.**DISTRIBUTION****Range:** New England and northern New York west across the upper Great Lakes to Minnesota, and adjacent Canada, southward to Pennsylvania and Ohio; mostly north of the glacial boundary.**Divisions:** 201:C**TNC Ecoregions:** 47:C, 48:C, 49:C, 59:C, 60:C, 61:C, 63:C, 64:C**Nations:** CA, US**Subnations:** CT, IL?, IN?, MA, ME, MI, MN, NB, NH, NY, OH?, ON, PA, QC, RI, VT, WI**Map Zones:** 41:C, 49:?, 50:C, 51:C, 52:?, 60:C, 61:C, 62:P, 63:C, 64:C, 65:C, 66:C**USFS Ecomap Regions:** 212Ha:CCC, 212Hb:CCC, 212Hc:CCC, 212Hd:CCC, 212He:CCC, 212Hf:CCC, 212Hg:CCC, 212Hh:CCC, 212Hi:CCC, 212Hj:CCC, 212Hk:CCC, 212Hl:CCC, 212Hm:CCC, 212J:CC, 212K:CC, 212L:CC, 212M:CC, 212N:CC, 212Q:CC, 212Ra:CCC, 212Rb:CCC, 212Rc:CCC, 212Rd:CCC, 212Re:CCC, 212S:CC, 212T:CC, 212X:CC, 212Y:CC, 212Z:CC, 222K:CC, 222M:CC, 222R:CC, 222Ue:CCC**CONCEPT****Associations:**

- *Calamagrostis canadensis* - *Scirpus* spp. - *Dulichium arundinaceum* Herbaceous Vegetation (CEGL006519, GNR)
- *Cornus sericea* - *Salix* spp. - (*Rosa palustris*) Shrubland (CEGL002186, G5)
- *Equisetum fluviatile* - (*Eleocharis palustris*) Herbaceous Vegetation (CEGL005258, G4)
- *Carex lacustris* Herbaceous Vegetation (CEGL002256, G4G5)
- *Myrica gale* - *Spiraea alba* - *Chamaedaphne calyculata* Shrubland (CEGL006512, GNR)
- *Alnus serrulata* Swamp Shrubland (CEGL005082, G4G5)
- *Alnus incana* Swamp Shrubland (CEGL002381, G5)
- *Cephalanthus occidentalis* / *Carex* spp. Northern Shrubland (CEGL002190, G4)
- *Calamagrostis canadensis* - *Eupatorium maculatum* Herbaceous Vegetation (CEGL005174, G4G5)
- *Scirpus cyperinus* Seasonally Flooded Herbaceous Vegetation (CEGL006349, GNR)
- *Carex tetanica* - *Carex prairea* - *Eleocharis erythropoda* - *Lysimachia quadriflora* Herbaceous Vegetation (CEGL006170, G1Q)
- *Carex stricta* - *Carex* spp. Herbaceous Vegetation (CEGL002258, G4?)
- *Carex (rostrata, utriculata)* - *Carex lacustris* - (*Carex vesicaria*) Herbaceous Vegetation (CEGL002257, G4G5)
- *Carex stricta* - *Carex vesicaria* Herbaceous Vegetation (CEGL006412, G4G5)
- *Juncus effusus* Seasonally Flooded Herbaceous Vegetation (CEGL004112, G5)
- *Typha latifolia* - *Caltha palustris* Herbaceous Vegetation (CEGL006245, G1)

High-ranked species: *Appalachia arcana* (G2G3), *Brychius hungerfordi* (G1), *Calephelis muticum* (G3), *Clonophis kirtlandii* (G2), *Grus americana* (G1), *Ophiogomphus susbehcha* (G2), *Oxytropis campestris* var. *chartacea* (G5T1T2), *Platanthera leucophaea* (G2G3), *Polemonium vanbruntiae* (G3G4), *Schoenoplectus hallii* (G2G3), *Scirpus ancistrochaetus* (G3), *Somatochlora hineana* (G2G3)**SOURCES****References:** Comer and Albert 1997, Eastern Ecology Working Group n.d., Gawler and Cutko 2010**Version:** 11 Apr 2007**Stakeholders:** Canada, East, Midwest**Concept Author:** S.C. Gawler, D. Faber-Langendoen**LeadResp:** East

CES202.701 NORTH-CENTRAL INTERIOR WET MEADOW-SHRUB SWAMP**Primary Division:** Central Interior and Appalachian (202)**Land Cover Class:** Woody Wetland**Spatial Scale & Pattern:** Small patch**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Wetland**Diagnostic Classifiers:** Depressional [Lakeshore]; Broad-Leaved Shrub; Graminoid

Concept Summary: This system is found throughout the northern Midwest ranging into southern Canada. It is typically found on glacial potholes, river valleys, ponds, channels in glacial outwash, and on lakeplains. This system contains a deep to shallow area of freshwater marsh dominated by emergent species surrounded by a zone of wet meadow. The emergent marsh zone within this system contains hydric soils flooded by water ranging from several centimeters to over 1 meter for most of the growing season. Emergent marsh species such as *Typha* spp. and *Schoenoplectus* spp. dominate the core of this system. Wet meadows can surround the emergent marsh core along wet mineral soils or shallow peat with the water table typically just below the surface for most of the growing season. The vegetation in this zone of the system is dominated by sedges (*Carex* spp.) and grasses such as *Calamagrostis canadensis*. This system also can contain a zone of wet prairie species such as *Spartina pectinata*. Shrub swamps can also be associated with the wet meadows within this system. Typical shrub species include *Cornus* spp., *Salix* spp., and/or *Cephalanthus occidentalis*. Trees are generally absent and, if present, are scattered. Fire originating in adjacent uplands, as well as hydrology, can influence this system. In the absence of fire, drought and/or ditching can increase the proportion of shrubs compared to the wet meadow or prairie species.

Comments: If examples of these associations are found within a medium to large floodplain, they should be considered part of North-Central Interior Floodplain (CES202.694). The freshwater marsh component was removed from this system to create a new system, North-Central Interior Freshwater Marsh (CES202.899).

DISTRIBUTION**Range:** This system is found in the northern Midwest and southern Canada.**Divisions:** 201:C, 202:C**TNC Ecoregions:** 35:C, 36:C, 45:C, 46:C, 47:C, 48:C, 49:?**Nations:** CA, US**Subnations:** IA, IL, IN, MI, MN, MO, ND, OH, ON, SD, WI**Map Zones:** 39:C, 40:C, 41:C, 42:C, 43:C, 44:P, 49:C, 50:C, 51:C, 52:C, 62:P**USFS Ecomap Regions:** 212Hb:CCP, 222Ja:CCC, 222Jb:CCC, 222Jc:CCC, 222Je:CCC, 222Jg:CCC, 222Jh:CCC, 222Ji:CCC, 222Ua:CCC, 222Ud:CCC, 222Ue:CCC**CONCEPT****Associations:**

- *Carex crinita* - *Osmunda* spp. / *Physocarpus opulifolius* Seep Herbaceous Vegetation (CEGL002392, G2)
- *Spartina pectinata* - *Carex* spp. - *Calamagrostis canadensis* Sand Herbaceous Vegetation (CEGL005178, G3?)
- *Cornus sericea* - *Salix* spp. - (*Rosa palustris*) Shrubland (CEGL002186, G5)
- *Carex lacustris* Herbaceous Vegetation (CEGL002256, G4G5)
- *Carex atherodes* Herbaceous Vegetation (CEGL002220, G3G5)
- *Spartina pectinata* - *Calamagrostis stricta* - *Carex* spp. Herbaceous Vegetation (CEGL002027, G3?)
- *Cephalanthus occidentalis* / *Carex* spp. Northern Shrubland (CEGL002190, G4)
- *Calamagrostis canadensis* - *Eupatorium maculatum* Herbaceous Vegetation (CEGL005174, G4G5)
- *Spiraea tomentosa* - *Salix humilis* / *Andropogon gerardii* - *Panicum virgatum* Shrubland (CEGL005069, G1Q)
- *Carex stricta* - *Carex* spp. Herbaceous Vegetation (CEGL002258, G4?)
- *Spartina pectinata* - *Carex* spp. - *Calamagrostis canadensis* - *Lythrum alatum* - (*Oxypolis rigidior*) Herbaceous Vegetation (CEGL002224, G3?)
- *Carex aquatilis* - *Carex* spp. Herbaceous Vegetation (CEGL002262, G4?)
- *Carex (rostrata, utriculata)* - *Carex lacustris* - (*Carex vesicaria*) Herbaceous Vegetation (CEGL002257, G4G5)
- *Cornus sericea* - *Salix (bebbiana, discolor, petiolaris)* / *Calamagrostis stricta* Shrubland (CEGL002187, G3G4)

High-ranked species: *Calephelis muticum* (G3), *Clonophis kirtlandii* (G2), *Grus americana* (G1), *Platanthera leucophaea* (G2G3), *Schoenoplectus hallii* (G2G3), *Scirpus ancistrochaetus* (G3), *Valeriana edulis* var. *ciliata* (G5T3)

Environment: This system is typically found on glacial potholes, river valleys, ponds, channels in glacial outwash, and on lakeplains. It contains a deep to shallow area of freshwater marsh dominated by emergent species surrounded by a zone of wet meadow. The emergent marsh zone within this system contains hydric soils flooded by water ranging from several centimeters to over 1 meter for most of the growing season.

Vegetation: Emergent marsh species such as *Typha* spp. and *Schoenoplectus* spp. dominate the core of this system. Wet meadows can surround the emergent marsh core along wet mineral soils or shallow peat with the water table typically just below the surface for most of the growing season. The vegetation in this zone of the system is dominated by sedges (*Carex* spp.) and grasses such as *Calamagrostis canadensis*. This system also can contain a zone of wet prairie species such as *Spartina pectinata*. Shrub swamps can also be associated with the wet meadows within this system. Typical shrub species include *Cornus* spp., *Salix* spp., and/or *Cephalanthus occidentalis*. Trees are generally absent and, if present, are scattered.

Dynamics: Fire originating in adjacent uplands, as well as hydrology, can influence this system. In the absence of fire, drought and/or ditching can increase the proportion of shrubs compared to the wet meadow or prairie species.

SOURCES

References: Comer and Albert 1997, Comer et al. 2003

Version: 18 Jul 2006

Concept Author: S. Menard

Stakeholders: Canada, Midwest, Southeast

LeadResp: Midwest

CES201.034 NORTHERN GREAT LAKES INTERDUNAL WETLAND

Primary Division: Laurentian-Acadian (201)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland

Diagnostic Classifiers: Mineral: W/ A-Horizon <10 cm; Intermittent Flooding; Coastal Dune Mosaic

Concept Summary: This system occurs in scattered location along the northern Great Lakes shoreline where coastal dunes are low and support swales close to lake water levels. The swale immediately behind the foredune is influenced by short-term variation in lake levels and can be partially or occasionally completely filled by dune sands following major storm events. Species common to this first swale include *Juncus balticus*, *Juncus pelocarpus*, *Juncus nodosus*, *Eleocharis acicularis*, species of *Solidago* such as *Oligoneuron houghtonii* (= *Solidago houghtonii*), and *Schoenoplectus americanus* (= *Scirpus americanus*). Occasionally, such swales may contain lake-influenced, calcareous sands, and the shallow swale may contain moderately alkaline indicators, such as *Cladium mariscoides*, *Myrica gale*, *Dasiphora fruticosa ssp. floribunda* (= *Pentaphylloides floribunda*), and others.

Comments: While this type is most commonly described from the northern Great Lakes region, there are likely more occurrences across the southern half of the Great Lakes that may vary in floristic composition from the type described here. Interdunal wetlands are treated as a separate type from dune and swale because in more active wave environments there are single swales immediately adjacent to the shore, with no series of swales/ridges further inland (D. Albert pers. comm.). The flora is typically herb-dominated and the dynamics are extreme due to water-level fluctuations (D. Albert pers. comm.).

DISTRIBUTION

Range: This system occurs in scattered locations along the northern Great Lakes shoreline.

Divisions: 201:C, 202:?

TNC Ecoregions: 48:C

Nations: CA, US

Subnations: MI, ON, WI

Map Zones: 49:?, 50:C, 51:C

USFS Ecomap Regions: 212Ha:CCC, 212Hf:CCC, 212Hj:CCC, 212Hl:CCC, 212Ra:CCC, 212Rc:CCC, 212Rd:CCP, 212Re:CCC, 212Sb:CCC, 212Sc:CCC, 212Sn:CCC, 212Sq:CCC, 212Te:CCC, 212Ya:CCP, 222Ja:CCC, 222Ud:CCC, 222Ue:CCC

CONCEPT

Associations:

- *Dasiphora fruticosa ssp. floribunda* / *Cladium mariscoides* - *Juncus balticus* - (*Rhynchospora capillacea*) Herbaceous Vegetation (CEGL005105, G3?)

High-ranked species: *Catinella exile* (G2), *Oligoneuron houghtonii* (G3), *Sarracenia purpurea ssp. heterophylla* (G5T1T2Q), *Trimerotropis huroniana* (G2G3)

SOURCES

References: Comer and Albert 1993, Comer and Albert 1997, Comer et al. 2003

Version: 11 Apr 2007

Concept Author: P. Comer

Stakeholders: Canada, Midwest

LeadResp: Midwest

G125. Eastern North American Freshwater Marsh

CES202.033 GREAT LAKES FRESHWATER ESTUARY AND DELTA

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland

Diagnostic Classifiers: Herbaceous; Riverine / Alluvial; Tidal / Estuarine

Concept Summary: This system is found throughout the southern Great Lakes Basin in the United States and Canada. It can include many associated wetlands occurring along portions of tributary rivers and streams that are directly affected by Great Lakes water regimes. It also forms much of the St. Clair River delta. Species distributions and community patterns are determined by multiple

abiotic factors, including the type of aquatic system (major river channels, smaller tributary rivers, major deltas, or estuarine), Great Lakes water-level fluctuations, surficial bedrock, glacial landform, climate, and land use. Although wetland species are generally widely distributed, those of more temperate prairie regions are found in the southern parts of the basin. Vegetation types found across this diverse set of abiotic factors can be placed into a number of zones, though not all are present at a given site. The first four zones are typically inundated directly by lake waters: (a) submergent marsh; (b) emergent marsh; (c) shore fen; and (d) shoreline or strand. The next set of zones are inland from the water's edge and include: (e) herbaceous and shrubby wet meadows and (f) shrub or wooded swamps.

This system can be divided into a number of geographical variants, based on the various community types found across the range of the system: (1) Lake Michigan Lacustrine Estuary; (2) Lake Erie-St. Clair Lakeplain Marsh; (3) Lake Ontario Lagoon Marsh; and (4) St Lawrence River Estuary.

DISTRIBUTION

Range: Throughout the southern Great Lakes Basin in the United States and Canada.

Divisions: 201:?, 202:C

TNC Ecoregions: 48:C

Nations: CA, US

Subnations: MI, NY, OH, ON, PA

Map Zones: 41:P, 49:C, 50:C, 51:C, 52:C, 62:C, 63:C, 64:C

USFS Ecomap Regions: 212Ha:CCC, 212Hf:CCC, 212Hj:CCC, 212Hl:CCC, 212Lb:CCP, 212Ra:CCC, 212Rc:CCC, 212Rd:CCC, 212Re:CCC, 212Sc:CCC, 212Sn:CCC, 212Sq:CCC, 212Te:CCC, 212Y:CC, 222Ja:CCC, 222Ua:CCC, 222Ud:CCC, 222Ue:CCC

CONCEPT

Associations:

- *Potamogeton zosteriformis* - *Ceratophyllum demersum* - *Elodea canadensis* Southern Great Lakes Shore Herbaceous Vegetation (CEGL005152, G3G4)
- *Nelumbo lutea* Herbaceous Vegetation (CEGL004323, G4?)
- *Typha* spp. - *Schoenoplectus tabernaemontani* - Mixed Herbs Southern Great Lakes Shore Herbaceous Vegetation (CEGL005112, G3G4)
- *Calamagrostis canadensis* - *Carex viridula* - *Cladium mariscoides* - *Lobelia kalmii* Herbaceous Vegetation (CEGL005115, G1G2)
- *Nuphar advena* - *Nymphaea odorata* Herbaceous Vegetation (CEGL002386, G4G5)
- *Carex* spp. - (*Carex pellita*, *Carex vulpinoidea*) Herbaceous Vegetation (CEGL005272, GNR)

Environment: Species distributions and community patterns are determined by multiple abiotic factors. Great Lakes water-level fluctuations, surficial bedrock, glacial landform, climate, and land use. Great Lakes water level fluctuate over at least three temporal time scales: first, short-term fluctuations caused by winds or barometric pressures; second, seasonal fluctuations reflecting the annual hydrologic cycle in the basin; and third, interannual fluctuations in lake level as a result of variable precipitation and evaporation within the drainage basin. Interannual fluctuations can be as much as 1.3-2.5 m, with apparently little or no periodicity. These fluctuations, which also alter turbidity, nutrient availability, ice scour zones, etc., cause locational shifts in vegetation zones, but also in the composition of these zones, as species have individual tolerance limits. The major bedrock distinction in the Great Lakes Basin is between igneous and metamorphic bedrock of the Precambrian period and younger (Paleozoic) sedimentary bedrock. The igneous and metamorphic bedrock form the rugged north shore of Lake Superior and Georgian Bay, and line much of the St. Lawrence River; they are locally present on the south shore of western Lake Superior. They lack the shallow protected waters and fine-textured substrates that support broad coastal wetlands. Where such bedrock is at or near the surface, it forms soils that are nutrient-poor and acidic. The rest of the basin is dominated by softer, sedimentary bedrock, which, with its broad, horizontal depositions, favors broad zones of shallow waters. The sedimentary rocks are typically more alkaline (calcareous), forming soils that are nutrient- and moisture-rich loams and clays. Bedrock patterns are overlaid by glacial landforms that, in combination with recent long-shore transport processes, create the prevalent physiographic features of the shorelines. In the lakes themselves, sand lakeplains, clay lakeplains, and moraines are shaped by currents, and the long-shore transportation of sediments has created sand-spit embayments and swales, dune-swale complexes, and tombolos. Channels and rivers contain channel-side wetlands, embayments, and deltas, and estuaries form as either open or barred river mouths. It is this diversity of landforms that has given rise to a diverse set of vegetation types. Finally, regional patterns of climate affect the basin. The strong latitudinal gradient from southern Lake Erie to northern Lake Superior creates marked differences in length of growing season and solar radiation. Although wetland species are generally widely distributed, those of more temperate and prairie regions are found in the southern parts.

Vegetation: Vegetation types found across this diverse set of abiotic factors vary in any number of ways, but they can be placed into a number of zones, though not all are present at a given site. The first four zones are typically inundated directly by lake waters: (a) submergent marsh - containing submergent and/or floating vegetation; (b) emergent marsh - characterized by shallow water or semipermanently flooded soils, and typically dominated by bulrushes, cattails, and other emergent species, but also containing submergent and/or floating vegetation; (c) shore fen - saturated vegetation mats characterized by groundwater influence from shoreline habitats but affected by lake level fluctuations, and dominated by herbaceous or shrubby species; and (d) shoreline or strand - a narrow zone at or just above the water level where seasonal water-level fluctuations and waves cause erosion, and which is dominated by annual or pioneer herbaceous species. The next set of zones are inland from the water's edge and include: (e) herbaceous

and shrubby wet meadows - characterized by saturated or seasonally flooded soils, and typically dominated by sedges, grasses, and other herbs, but occasionally dominated by shrubs; and (f) shrub or wooded swamps - characterized by seasonal flooding and dominated by woody species. Species assemblages in these zones change depending on the interaction of factors across the Great Lakes Basin.

SOURCES

References: Comer et al. 2003

Version: 26 Mar 2003

Concept Author: D. Albert, L. Minc

Stakeholders: Canada, East, Midwest

LeadResp: Midwest

CES201.594 LAURENTIAN-ACADIAN FRESHWATER MARSH

Primary Division: Laurentian-Acadian (201)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland

Diagnostic Classifiers: Depressional [Lakeshore]; Riverine / Alluvial; Graminoid; Shallow (<15 cm) Water; >180-day hydroperiod

Concept Summary: These freshwater emergent and/or submergent marshes are dominated by herbaceous vegetation. They are common throughout the northeastern United States and adjacent Canadian provinces. Freshwater marshes occur in closed or open basins that are generally flat and shallow. They are associated with lakes, ponds, slow-moving streams, and/or impoundments or ditches. The herbaceous vegetation does not persist through the winter. Scattered shrubs are often present and usually total less than 25% cover. Trees are generally absent and, if present, are scattered. The substrate is typically muck over mineral soil. Examples of vegetation in the Delaware Estuary freshwater marsh communities include *Typha latifolia*, *Typha angustifolia*, *Phragmites australis*, *Schoenoplectus americanus*, *Thelypteris palustris*, *Impatiens capensis*, *Carex* spp., *Vallisneria americana*, *Potamogeton perfoliatus*, *Nuphar advena* (= *Nuphar lutea* ssp. *advena*), and *Nymphaea odorata*.

DISTRIBUTION

Range: This system occurs in New England and northern New York west across the upper Great Lakes to Minnesota, and adjacent Canada, southward to Pennsylvania, New Jersey, and Ohio; mostly north of the glacial boundary.

Divisions: 201:C, 202:C

TNC Ecoregions: 47:C, 48:C, 49:C, 59:C, 60:C, 61:C, 63:C, 64:C

Nations: CA, US

Subnations: CT, IL?, IN?, MA, ME, MI, MN, NB, NH, NJ, NY, OH?, ON, PA, QC, RI, VT, WI

Map Zones: 41:C, 49:?, 50:C, 51:C, 52:?, 60:C, 61:C, 62:P, 63:C, 64:C, 65:C, 66:C

USFS Ecomap Regions: 212Ha:CCC, 212Hb:CCC, 212Hc:CCC, 212Hd:CCC, 212He:CCC, 212Hf:CCC, 212Hg:CCC, 212Hh:CCC, 212Hi:CCC, 212Hj:CCC, 212Hk:CCC, 212Hl:CCC, 212Hm:CCC, 212Ra:CCC, 212Rb:CCC, 212Rc:CCC, 212Rd:CCC, 212Re:CCC

CONCEPT

Associations:

- *Zizania (aquatica, palustris)* Herbaceous Vegetation (CEGL002382, G3G4)
- *Typha (angustifolia, latifolia)* - (*Schoenoplectus* spp.) Eastern Herbaceous Vegetation (CEGL006153, G5)
- *Schoenoplectus acutus* - *Carex lasiocarpa* Herbaceous Vegetation (CEGL006358, G1G2)
- *Potamogeton* spp. - *Ceratophyllum* spp. Midwest Herbaceous Vegetation (CEGL002282, G5)
- *Nymphaea tetragona* - *Nuphar (microphylla, variegata)* Herbaceous Vegetation (CEGL002563, G4G5)
- *Equisetum fluviatile* - (*Eleocharis palustris*) Herbaceous Vegetation (CEGL005258, G4)
- *Schoenoplectus fluviatilis* - *Schoenoplectus* spp. Herbaceous Vegetation (CEGL002221, G3G4)
- *Juncus militaris* - *Eriocaulon aquaticum* Herbaceous Vegetation (CEGL006345, GNR)
- *Schoenoplectus tabernaemontani* - *Typha* spp. - (*Sparganium* spp., *Juncus* spp.) Herbaceous Vegetation (CEGL002026, G4G5)
- *Schoenoplectus (tabernaemontani, acutus)* Eastern Herbaceous Vegetation (CEGL006275, GNR)
- *Pontederia cordata* - *Peltandra virginica* - *Sagittaria latifolia* Herbaceous Vegetation (CEGL006191, G5)
- *Vallisneria americana* - *Potamogeton perfoliatus* Herbaceous Vegetation (CEGL006196, G5)
- *Schoenoplectus fluviatilis* Herbaceous Vegetation (CEGL006366, GNR)
- *Bidens cernua* - *Verbena hastata* - *Polygonum* spp. Herbaceous Vegetation (CEGL006446, GNR)
- *Schoenoplectus acutus* - (*Schoenoplectus fluviatilis*) Freshwater Herbaceous Vegetation (CEGL002225, G4G5)
- *Nymphaea odorata* - *Nuphar (microphylla, variegata)* Herbaceous Vegetation (CEGL002562, G5)
- *Scirpus cyperinus* Seasonally Flooded Herbaceous Vegetation (CEGL006349, GNR)
- *Typha* spp. - *Schoenoplectus acutus* - Mixed Herbs Midwest Herbaceous Vegetation (CEGL002229, G4?)
- *Elodea canadensis* - *Potamogeton* spp. Eastern Herbaceous Vegetation (CEGL006431, GNR)
- *Eriocaulon aquaticum* - *Lobelia dortmanna* Herbaceous Vegetation (CEGL006346, GNR)
- *Nuphar advena* - *Nymphaea odorata* Herbaceous Vegetation (CEGL002386, G4G5)

High-ranked species: *Catinella exile* (G2), *Clonophis kirtlandii* (G2), *Grus americana* (G1), *Isoetes hieroglyphica* (G1G2Q), *Oxytropis campestris* var. *chartacea* (G5T1T2), *Somatochlora hineana* (G2G3)

SOURCES

References: Comer and Albert 1997, Eastern Ecology Working Group n.d., Gawler and Cutko 2010

Version: 22 Dec 2005

Stakeholders: Canada, East, Midwest

Concept Author: S.C. Gawler, D. Faber-Langendoen

LeadResp: East

CES202.899 NORTH-CENTRAL INTERIOR FRESHWATER MARSH

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland

Diagnostic Classifiers: Depressional [Lakeshore]; Graminoid; Shallow (<15 cm) Water; >180-day hydroperiod

Concept Summary: This system is found throughout the northern Midwest ranging into southern Canada. It is typically found on glacial potholes, along small streams, ponds, channels in glacial outwash and on lakeplains. This system contains a deep to shallow area of freshwater marsh dominated by emergent and submergent species. Stands may be open ponds with floating or rooted aquatics, or deep marsh with bulrush or cattails, and range from fairly small to several acres. It contains hydric soils flooded by water ranging from several centimeters to over 1 meter for most of the growing season. Emergent marsh species such as *Typha* spp. and *Schoenoplectus* spp. dominate this system with an occasional scattering of tall *Carex* spp. and forbs that can vary from dense to open cover. Trees are generally absent and, if present, are scattered. Submergent wetlands include a variety of macrophytes.

Comments: Some of the specific communities will also be found in the floodplain system and should not be considered a separate system in that case [see North-Central Interior Floodplain (CES202.694)]. Many of these marshes also may have a border of shrubby wet-meadow species similar to North-Central Interior Wet Meadow-Shrub Swamp (CES202.701), but only those areas with a relatively narrow border (<5-10 m) should included with this system.

DISTRIBUTION

Range: This system is found in the northern Midwest and southern Canada.

Divisions: 201:C, 202:C

TNC Ecoregions: 35:C, 36:C, 45:C, 46:C, 47:C, 48:C, 49:?

Nations: CA?, US

Subnations: IA, IL, IN, MI, MN, MO, ND, OH, ON?, SD, WI

Map Zones: 39:C, 40:C, 41:P, 42:C, 43:C, 44:P, 49:C, 50:C, 51:C, 52:C, 62:P

USFS Ecomap Regions: 222Ja:CCC, 222Jb:CCC, 222Jc:CCC, 222Je:CCC, 222Jg:CCC, 222Jh:CCC, 222Ji:CCC, 222Ua:CCC, 222Ud:CCC, 222Ue:CCC

CONCEPT

Associations:

- *Phragmites australis* Eastern North America Temperate Semi-natural Herbaceous Vegetation (CEGL004141, GNA)
- *Zizania (aquatica, palustris)* Herbaceous Vegetation (CEGL002382, G3G4)
- *Polygonum* spp. - Mixed Forbs Herbaceous Vegetation (CEGL002430, G4G5)
- *Potamogeton* spp. - *Ceratophyllum* spp. Midwest Herbaceous Vegetation (CEGL002282, G5)
- *Schoenoplectus fluviatilis* - *Schoenoplectus* spp. Herbaceous Vegetation (CEGL002221, G3G4)
- *Nelumbo lutea* Herbaceous Vegetation (CEGL004323, G4?)
- *Schoenoplectus acutus* - (*Schoenoplectus fluviatilis*) Freshwater Herbaceous Vegetation (CEGL002225, G4G5)
- *Typha* spp. - *Schoenoplectus acutus* - Mixed Herbs Midwest Herbaceous Vegetation (CEGL002229, G4?)
- *Typha* spp. Midwest Herbaceous Vegetation (CEGL002233, G5)
- *Nuphar advena* - *Nymphaea odorata* Herbaceous Vegetation (CEGL002386, G4G5)

High-ranked species: *Clonophis kirtlandii* (G2)

Environment: This system is typically found on glacial potholes, along small streams, ponds, channels in glacial outwash, and on lakeplains. This system contains a deep to shallow area of freshwater marsh dominated by emergent and submergent species. It contains hydric soils flooded by water ranging from several centimeters to over 1 meter for most of the growing season.

Vegetation: This system contains a deep to shallow area of freshwater marsh dominated by emergent and submergent species. Stands may be open ponds with floating or rooted aquatics, or deep marsh with bulrush or cattails, and range from fairly small to several acres. Emergent marsh species such as *Typha* spp. and *Schoenoplectus* spp. dominate this system with an occasional scattering of tall *Carex* spp. and forbs that can vary from dense to open cover. Trees are generally absent and, if present, are scattered. Submergent wetlands include a variety of macrophytes.

SOURCES

References: Comer and Albert 1997, Midwestern Ecology Working Group n.d.

Version: 18 Jul 2006

Stakeholders: Canada, Midwest, Southeast

CES201.722 NORTHERN GREAT LAKES COASTAL MARSH**Primary Division:** Laurentian-Acadian (201)**Land Cover Class:** Herbaceous Wetland**Spatial Scale & Pattern:** Large patch**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Wetland

Concept Summary: This system is found throughout the northern Great Lakes Basin in the United States and Canada. This system, which can include many associated wetlands, occurs along the Great Lakes shoreline directly affected by Great Lakes water regimes. Species distributions and community patterns are determined by multiple abiotic factors, including Great Lakes water-level fluctuations, surficial bedrock, glacial landform, climate, and land use. Although wetland species are generally widely distributed, those of more boreal and subarctic regions are found in the northern parts of the basin.

Vegetation types found across this diverse set of abiotic factors vary in any number of ways, but they can be placed into a number of zones, though not all are present at a given site. The first four zones are typically inundated directly by lake waters: (a) submergent marsh; (b) emergent marsh; (c) shore fen; and (d) shoreline or strand. The next set of zones are inland from the water's edge and include: (e) herbaceous and shrubby wet meadows and (f) shrub or wooded swamps.

This system can be divided into a number of geographical variants, based on the various community types found across the range of the system: (1) Lake Superior Poor Fen; (2) Northern Rich Fen; (3) Northern Great Lakes Marsh; (4) Green Bay Disturbed Marsh; (5) Lake Michigan Lacustrine Estuary; (6) Saginaw Bay Lakeplain Marsh; (7) Lake Erie-St. Clair Lakeplain Marsh; (8) Lake Ontario Lagoon Marsh; and (9) St Lawrence River Estuary.

Comments: Differs from Great Lakes Freshwater Estuary and Delta (CES202.033) based on its lakeshore setting; the estuary system occurs along rivers, where there is typically more nutrient (e.g., from silts).

DISTRIBUTION**Range:** This system is found throughout the northern Great Lakes Basin in the United States and Canada.**Divisions:** 201:C**TNC Ecoregions:** 48:C**Nations:** CA, US**Subnations:** MI, ON, WI**Map Zones:** 41:C, 49:?, 50:C, 51:C**USFS Ecomap Regions:** 212Ha:CCC, 212Hf:CCC, 212Hj:CCC, 212Hl:CCC, 212J:CC, 212Lb:CCP, 212Ra:CCC, 212Rc:CCC, 212Rd:CCC, 212Re:CCC, 212Sc:CCC, 212Sn:CCC, 212Sq:CCC, 212Te:CCC, 212Tf:CCC, 212Y:CC, 212Z:CC, 222Ja:CCC, 222Ua:CCC, 222Ud:CCC, 222Ue:CCC**CONCEPT****Associations:**

- *Potamogeton gramineus* - *Potamogeton natans* Northern Great Lakes Shore Herbaceous Vegetation (CEGL005273, G3?)
- *Potamogeton zosteriformis* - *Ceratophyllum demersum* - *Elodea canadensis* Southern Great Lakes Shore Herbaceous Vegetation (CEGL005152, G3G4)
- *Dasiphora fruticosa* ssp. *floribunda* - *Myrica gale* Rich Shore Fen Shrubland (CEGL005275, G1G2)
- *Calamagrostis canadensis* - *Carex viridula* - *Cladium mariscoides* - *Lobelia kalmii* Herbaceous Vegetation (CEGL005115, G1G2)
- *Carex (rostrata, utriculata)* - *Carex lacustris* - (*Carex vesicaria*) Herbaceous Vegetation (CEGL002257, G4G5)
- *Schoenoplectus acutus* - *Schoenoplectus subterminalis* - *Eleocharis palustris* - (*Schoenoplectus americanus*) Northern Great Lakes Shore Herbaceous Vegetation (CEGL005274, G3?)
- *Nuphar advena* - *Nymphaea odorata* Herbaceous Vegetation (CEGL002386, G4G5)

High-ranked species: *Trimerotropis huroniana* (G2G3)

Environment: Species distributions and community patterns are determined by multiple abiotic factors. Great Lakes water-level fluctuations, surficial bedrock, glacial landform, climate, and land use. Great Lakes water level fluctuate over at least three temporal time scales: first, short-term fluctuations caused by winds or barometric pressures; second, seasonal fluctuations reflecting the annual hydrologic cycle in the basin; and third, interannual fluctuations in lake level as a result of variable precipitation and evaporation within the drainage basin. Interannual fluctuations can be as much as 1.3-2.5 m, with apparently little or no periodicity. These fluctuations, which also alter turbidity, nutrient availability, ice scour zones, etc., cause locational shifts in vegetation zones, but also in the composition of these zones, as species have individual tolerance limits. The major bedrock distinction in the Great Lakes Basin is between igneous and metamorphic bedrock of the Precambrian period and younger (Paleozoic) sedimentary bedrock. The igneous and metamorphic bedrock form the rugged north shore of Lake Superior and Georgian Bay, and line much of the St. Lawrence River; they are locally present on the south shore of western Lake Superior. They lack the shallow protected waters and fine-textured substrates that support broad coastal wetlands. Where such bedrock is at or near the surface, it forms soils that are nutrient-poor and acidic. The rest of the basin is dominated by softer, sedimentary bedrock, which, with its broad, horizontal depositions, favors broad

zones of shallow waters. The sedimentary rocks are typically more alkaline (calcareous), forming soils that are nutrient- and moisture-rich loams and clays. Bedrock patterns are overlaid by glacial landforms that, in combination with recent long-shore transport processes, create the prevalent physiographic features of the shorelines. In the lakes themselves, sand lakeplains, clay lakeplains, and moraines are shaped by currents, and the long-shore transportation of sediments has created sand-spit embayments and swales, dune-swale complexes, and tombolos. Channels and rivers contain channel-side wetlands, embayments, and deltas, and estuaries form as either open or barred river mouths. It is this diversity of landforms that has given rise to a diverse set of vegetation types. Finally, regional patterns of climate affect the basin. The strong latitudinal gradient from southern Lake Erie to northern Lake Superior creates marked differences in length of growing season and solar radiation. Although wetland species are generally widely distributed, those of more boreal and subarctic regions are found in the northern parts of the basin, whereas those of more temperate and prairie regions are found in the southern parts.

Vegetation: Vegetation types found across this diverse set of abiotic factors vary in any number of ways, but they can be placed into a number of zones, though not all are present at a given site. The first four zones are typically inundated directly by lake waters: (a) submergent marsh - containing submergent and/or floating vegetation; (b) emergent marsh - characterized by shallow water or semipermanently flooded soils, and typically dominated by bulrushes, cattails, and other emergent species, but also containing submergent and/or floating vegetation; (c) shore fen - saturated vegetation mats characterized by groundwater influence from shoreline habitats but affected by lake level fluctuations, and dominated by herbaceous or shrubby species; and (d) shoreline or strand - a narrow zone at or just above the water level where seasonal water-level fluctuations and waves cause erosion, and which is dominated by annual or pioneer herbaceous species. The next set of zones are inland from the water's edge and include: (e) herbaceous and shrubby wet meadows - characterized by saturated or seasonally flooded soils, and typically dominated by sedges, grasses, and other herbs, but occasionally dominated by shrubs; and (f) shrub or wooded swamps - characterized by seasonal flooding and dominated by woody species. Species assemblages in these zones change depending on the interaction of factors across the Great Lakes Basin.

SOURCES

References: Comer et al. 2003, Minc and Albert 1998

Version: 11 Apr 2007

Concept Author: D. Albert

Stakeholders: Canada, East, Midwest

LeadResp: Midwest

M071. GREAT PLAINS WET MEADOW, WET PRAIRIE & MARSH

G325. Great Plains Freshwater Marsh

CES303.661 GREAT PLAINS PRAIRIE POTHOLE

Primary Division: Western Great Plains (303)

Land Cover Class: Mixed Upland and Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland

National Mapping Codes: EVT 2482; ESLF 9203; ESP 1482

Concept Summary: The prairie pothole system is found primarily in the glaciated northern Great Plains of the United States and Canada, and is dominated by depressional wetlands formed by glaciers scraping the landscape during the Pleistocene era. This system is typified by several classes of wetlands distinguished by changes in topography, soils and hydrology. Many of the basins within this system are closed basins and receive irregular inputs of water from their surroundings (groundwater and precipitation), and export water as groundwater. Hydrology of the potholes is complex. Precipitation and runoff from snowmelt are often the principal water sources, with groundwater inflow secondary. Evapotranspiration is the major water loss, with seepage loss secondary. Most of the wetlands and lakes contain water that is alkaline (pH >7.4). The concentration of dissolved solids result in water that ranges from fresh to extremely saline. The flora and vegetation of this system are a function of the topography, water regime, and salinity. In addition, because of periodic droughts and wet periods, many wetlands within this system may undergo vegetation cycles. This system includes elements of emergent marshes and wet, sedge meadows that develop into a pattern of concentric rings. This system is responsible for a significant percentage of the annual production of many economically important waterfowl in North America and houses more than 50% of North American's migratory waterfowl, with several species reliant on this system for breeding and feeding. Much of the original extent of this system has been converted to agriculture, and only approximately 40-50% of the system remains undrained.

Comments: More data from Canada is needed to really define this system completely.

DISTRIBUTION

Range: This system can be found throughout the northern Great Plains ranging from central Iowa northeast to southern Saskatchewan and Alberta, and extending west into north-central Montana. It encompasses approximately 870,000 square km with approximately 80% of its range in southern Canada. It is also prevalent in North Dakota, South Dakota, and northern Minnesota.

Divisions: 205:C, 303:C

TNC Ecoregions: 26:C, 34:C, 35:C, 66:P, 67:P

Nations: CA, US

Subnations: AB, IA?, MB, MN, MT, ND, SD, SK, WY

Map Zones: 20:C, 29:C, 38:?, 39:C, 40:C, 41:C, 42:P

USFS Ecomap Regions: 251A:CC, 251B:CC, 331D:CC, 331E:CC, 331K:CC, 331L:CC, 331M:CC

CONCEPT

Associations:

- *Carex lasiocarpa* - *Carex oligosperma* / *Sphagnum* spp. Herbaceous Vegetation (CEGL002265, G3G4)
- *Schoenoplectus maritimus* - *Schoenoplectus acutus* - (*Triglochin maritima*) Herbaceous Vegetation (CEGL002227, G3G5)
- *Schoenoplectus maritimus* Herbaceous Vegetation (CEGL001843, G4)
- *Schoenoplectus acutus* - (*Schoenoplectus fluviatilis*) Freshwater Herbaceous Vegetation (CEGL002225, G4G5)
- Northern Prairie Pothole Wetland Complex (CECX005705, G3G5)

High-ranked species: *Platanthera leucophaea* (G2G3)

Environment: This system is dominated by closed basins, potholes, that receive irregular inputs of water from the surroundings and export water as groundwater. The climate for the range of this system is characterized by mid-continental temperature and precipitation extremes. Snowmelt in the spring typically fills many of the potholes in examples of this system. The region in the range of this system is distinguished by a thin mantle of glacial drift with overlying stratified sedimentary rocks of the Mesozoic and Cenozoic ages; these form a glacial landscape of end moraines, stagnation moraines, outwash plains and lakeplains. The glacial drift ranges 30 to 120 m thick and forms steep to slight local relief with fine-grained, silty to clayey soils. Limestone, sandstone, and shales predominant, and highly mineralized water can discharge from these rocks. The hydrology of this system is complex with salinity ranging from fresh to saline, and chemical characteristics varying seasonally and annually. Precipitation and snowmelt are the primary water sources with evapotranspiration being the source of major water loss.

Vegetation: The vegetation within this system is highly influenced by hydrology, salinity and dynamics. Potholes found within this system can vary in depth and duration, which will determine the local gradient of species. Likewise, plant species found within individual potholes of this system will be strongly influenced by periodic drought and wet periods. Deeper potholes with standing water throughout most of the year have a central zone of submersed aquatic vegetation. Potholes that dry during droughty times can have central zones dominated by either tall emergents or mid-height emergents depending on the depth of the marsh. Wet meadow species such as grasses, forbs and sedges can be found in potholes that are only flooded briefly in the spring. All of these types of potholes can be found within an example of this system. Grazing, draining, and mowing of this system can influence the distribution of these types of potholes and plant species within this system.

Dynamics: Flooding is the primary natural dynamic influencing this system. Snowmelt in the spring often floods this system and can cause the prominent potholes within the system to overflow. Greater than normal precipitation can flood out emergent vegetation and/or increase herbivory by animal species such as muskrats. This system can undergo periodic wet and droughty periods that can cause shifts in the vegetation. Vegetation zones are evident around the wet potholes throughout this system, and each zone responds to changing environmental conditions. Draining and conversion to agriculture can also significantly impact this system. Much of the original extent of this system has been converted to cropland, and many remaining examples are under pressure to be drained.

SOURCES

References: Comer et al. 2003, Johnson et al. 1987, Kantrud et al. 1989, Lesica 1989, Stewart and Kantrud 1972

Version: 05 Mar 2003

Stakeholders: Canada, Midwest, West

Concept Author: S. Menard

LeadResp: Midwest

G336. Great Plains Wet Prairie & Wet Meadow

CES205.687 EASTERN GREAT PLAINS WET MEADOW, PRAIRIE AND MARSH

Primary Division: Eastern Great Plains (205)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland

National Mapping Codes: EVT 2488; ESLF 9213; ESP 1488

Concept Summary: This system is found along creeks and streams from Nebraska and Iowa to Illinois, and from Minnesota to Texas. It is also found in depressions and along lake borders, especially in the northern extension of its range into Minnesota. It is often adjacent to a floodplain system but is devoid of trees and riparian vegetation. It is also distinguished from upland prairie systems by having more hydrology, especially associated with silty, dense clay soils that are often hydric, classified as Vertic Haplaquolls. The landform is usually floodplain or poorly drained, relatively level land. The vegetation is dominated by *Spartina pectinata*, *Tripsacum dactyloides*, numerous large sedges, such as *Carex frankii* and *Carex hyalinolepis*, and in wetter areas, *Eleocharis* spp. Other emergent marsh species such as *Typha* spp. can be associated with this system. Forbs can include *Helianthus grosseserratus*, *Vernonia fasciculata*, and *Physostegia virginiana*. Some parts of this system may be saline and have species such as *Distichlis spicata* and *Schoenoplectus maritimus*. Fire has been the primary influence in keeping these wet areas free of trees. Other dynamic processes include grazing and flooding (often in late spring). Many areas have been converted to agricultural, but this usually requires some sort of drainage.

DISTRIBUTION

Range: This system is found throughout the northeastern Great Plains ranging from eastern Kansas to western Illinois and north into Minnesota.

Divisions: 205:C

TNC Ecoregions: 35:C, 36:C, 45:P, 46:P

Nations: US

Subnations: IA, IL, KS, MN, MO, ND, NE, OK, SD, TX?

Map Zones: 31:P, 38:C, 39:C, 40:C, 41:P, 42:C, 43:C, 49:C, 50:C, 51:P, 52:P

USFS Ecomap Regions: 251A:CC, 251B:CC, 251E:CC, 251F:CC, 251G:CC, 251H:CC, 255A:PP, 332B:CP, 332C:CC, 332D:CC, 332E:CC, 332F:C?

CONCEPT**Associations:**

- *Spartina pectinata* - *Eleocharis* spp. - *Carex* spp. Herbaceous Vegetation (CEGL002223, G2G4)
- *Polygonum* spp. - Mixed Forbs Herbaceous Vegetation (CEGL002430, G4G5)
- *Spartina pectinata* - *Carex* spp. - *Calamagrostis canadensis* Sand Herbaceous Vegetation (CEGL005178, G3?)
- *Typha* (*angustifolia*, *domingensis*, *latifolia*) - *Schoenoplectus americanus* Herbaceous Vegetation (CEGL002032, G3G4)
- *Cornus sericea* - *Salix* spp. - (*Rosa palustris*) Shrubland (CEGL002186, G5)
- *Schoenoplectus maritimus* - *Atriplex patula* - *Eleocharis parvula* Herbaceous Vegetation (CEGL005111, G1)
- *Potamogeton* spp. - *Ceratophyllum* spp. Midwest Herbaceous Vegetation (CEGL002282, G5)
- *Distichlis spicata* - *Schoenoplectus maritimus* - *Salicornia rubra* Herbaceous Vegetation (CEGL002043, G1G2)
- *Carex lacustris* Herbaceous Vegetation (CEGL002256, G4G5)
- *Schoenoplectus fluviatilis* - *Schoenoplectus* spp. Herbaceous Vegetation (CEGL002221, G3G4)
- *Sagittaria latifolia* - *Leersia oryzoides* Herbaceous Vegetation (CEGL005240, GNR)
- *Carex atherodes* Herbaceous Vegetation (CEGL002220, G3G5)
- *Schoenoplectus tabernaemontani* - *Typha* spp. - (*Sparganium* spp., *Juncus* spp.) Herbaceous Vegetation (CEGL002026, G4G5)
- *Calamagrostis stricta* - *Carex sartwellii* - *Carex praegracilis* - *Plantago eriopoda* Saline Herbaceous Vegetation (CEGL002255, G2G3)
- *Spartina pectinata* - *Calamagrostis stricta* - *Carex* spp. Herbaceous Vegetation (CEGL002027, G3?)
- *Potamogeton nodosus* Herbaceous Vegetation (CEGL004529, GNR)
- *Ceratophyllum demersum* - *Stuckenia pectinata* Herbaceous Vegetation (CEGL004528, G4G5)
- *Schoenoplectus acutus* - (*Schoenoplectus fluviatilis*) Freshwater Herbaceous Vegetation (CEGL002225, G4G5)
- *Sagittaria cuneata* - *Sagittaria longiloba* Herbaceous Vegetation (CEGL004525, GNR)
- *Calamagrostis canadensis* - *Eupatorium maculatum* Herbaceous Vegetation (CEGL005174, G4G5)
- *Spiraea tomentosa* - *Salix humilis* / *Andropogon gerardii* - *Panicum virgatum* Shrubland (CEGL005069, G1Q)
- *Carex stricta* - *Carex* spp. Herbaceous Vegetation (CEGL002258, G4?)
- *Spartina pectinata* - *Carex* spp. - *Calamagrostis canadensis* - *Lythrum alatum* - (*Oxypolis rigidior*) Herbaceous Vegetation (CEGL002224, G3?)
- *Polygonum amphibium* - (*Polygonum hydropiperoides*) Seasonally Flooded Herbaceous Vegetation (CEGL004699, G4G5)
- *Typha latifolia* - *Thalia dealbata* Herbaceous Vegetation (CEGL004526, GNR)
- *Carex aquatilis* - *Carex* spp. Herbaceous Vegetation (CEGL002262, G4?)
- *Typha* spp. - *Schoenoplectus acutus* - Mixed Herbs Midwest Herbaceous Vegetation (CEGL002229, G4?)
- *Carex pellita* - *Calamagrostis stricta* Herbaceous Vegetation (CEGL002254, G3G5)
- *Carex (rostrata, utriculata)* - *Carex lacustris* - (*Carex vesicaria*) Herbaceous Vegetation (CEGL002257, G4G5)
- *Impatiens pallida* - *Cystopteris bulbifera* - *Adoxa moschatellina* - (*Chrysosplenium iowense*, *Aconitum noveboracense*) Herbaceous Vegetation (CEGL002387, G2)
- *Typha* spp. Midwest Herbaceous Vegetation (CEGL002233, G5)
- *Cornus sericea* - *Salix* (*bebbiana*, *discolor*, *petiolaris*) / *Calamagrostis stricta* Shrubland (CEGL002187, G3G4)
- *Nuphar advena* - *Nymphaea odorata* Herbaceous Vegetation (CEGL002386, G4G5)

High-ranked species: *Calephelis muticum* (G3), *Platanthera leucophaea* (G2G3), *Schoenoplectus hallii* (G2G3)

Environment: This system is found primarily on silty and/or dense clay, hydric soils, usually classified as Vertic Haplaquolls. It is often found within poorly drained, relatively level areas.

Vegetation: *Spartina pectinata*, *Tripsacum dactyloides*, and numerous large sedges, such as *Carex frankii* and *Carex hyalinolepis*, dominate this system. In wetter areas, *Eleocharis* spp. and *Typha* spp. may be significant. Forbs such as *Helianthus grosseserratus*, *Vernonia fasciculata*, and *Physostegia virginiana* also may be common. Shrub species can be present, especially in the northern range of this system; however, they are usually insignificant compared to the prairie and meadow species.

Dynamics: Fire is the major dynamic process that helps maintain the herbaceous nature of this system and prevents trees from establishing. Grazing and periodic flooding can also influence this system.

SOURCES

References: Comer et al. 2003, Lauver et al. 1999, Rolfsmeier and Steinauer 2010, Steinauer and Rolfsmeier 2000

Version: 18 Jul 2006

Concept Author: S. Menard and K. Kindscher

Stakeholders: Canada, Midwest, Southeast

LeadResp: Midwest

CES202.027 GREAT LAKES WET-MESIC LAKEPLAIN PRAIRIE

Primary Division: Central Interior and Appalachian (202)**Land Cover Class:** Mixed Upland and Wetland**Spatial Scale & Pattern:** Large patch**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland**National Mapping Codes:** EVT 2411; ESLF 7124; ESP 1411

Concept Summary: This system is found on the lakeplain near the southern central Great Lakes of the United States and Canada. Stands occur on level, sandy glacial outwash, sandy glacial lakeplains, and deposits of dune sand in silty/clayey glacial lakeplains. The soils are sands and sandy loams, loams with poor to moderate water-retaining capacity, typically occurring over less permeable silty clays. There is often temporary inundations after heavy rains or in the spring, followed by dry conditions throughout much of the remaining growing season. The vegetation of this community is dominated by tallgrass species typically 1-2 m high. Trees and shrubs are very rare. There is very little bare ground. *Andropogon gerardii*, *Calamagrostis canadensis*, *Carex* spp. (*Carex aquatilis*, *Carex bicknellii*, *Carex buxbaumii*, *Carex pellita* (= *Carex lanuginosa*)), *Panicum virgatum*, *Spartina pectinata*, *Schizachyrium scoparium*, and *Sorghastrum nutans* are the most abundant graminoid species. Many of the sites that this system formerly occupied are now urban and/or agricultural. Areas around Chicago and Detroit were likely in this system but are heavily converted now and few sites remain.

DISTRIBUTION

Range: This system is found near the southern central Great Lakes of the United States and Canada, from southeastern Wisconsin and northeastern Illinois to southern Michigan and southwestern Ontario. This does not go farther east than northwestern Ohio (glacial Lake Maumee).

Divisions: 202:C**TNC Ecoregions:** 48:C**Nations:** CA, US**Subnations:** IL, IN, MI, OH, ON, WI**Map Zones:** 41:?, 49:C, 50:C, 51:C, 52:C**USFS Ecomap Regions:** 222Ja:CCC, 222K:CC, 222Ua:CCC, 222Ud:CCC, 222Ue:CCC**CONCEPT****Associations:**

- *Spartina pectinata* - *Carex* spp. - *Calamagrostis canadensis* Lakeplain Herbaceous Vegetation (CEGL005109, G2G3)
- *Quercus alba* - *Quercus velutina* - *Quercus palustris* / *Carex pensylvanica* Woodland (CEGL005054, G2)
- *Andropogon gerardii* - *Sorghastrum nutans* - *Schizachyrium scoparium* - *Aletris farinosa* Herbaceous Vegetation (CEGL005096, G2)
- *Andropogon gerardii* - *Calamagrostis canadensis* - *Pycnanthemum virginianum* - *Oligoneuron ohioense* Herbaceous Vegetation (CEGL005095, G2)

High-ranked species: *Clonophis kirtlandii* (G2), *Papaipema beeriana* (G2G3), *Platanthera leucophaea* (G2G3)**SOURCES**

References: Chapman 1984, Chapman et al. 1989, Comer et al. 1995b, Comer et al. 2003, Faber-Langendoen and Maycock 1987, Faber-Langendoen and Maycock 1994

Version: 20 Jul 2007

Concept Author: K. Chapman, D. Faber-Langendoen, P. Comer

Stakeholders: Canada, Midwest

LeadResp: Midwest

M160. NORTHERN & CENTRAL TALL SHRUB WETLAND

G599. Central Shrub & Herb Depression Pond

CES202.018 CENTRAL INTERIOR HIGHLANDS AND APPALACHIAN SINKHOLE AND DEPRESSION POND

Primary Division: Central Interior and Appalachian (202)**Land Cover Class:** Woody Wetland**Spatial Scale & Pattern:** Small patch**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Wetland**Diagnostic Classifiers:** Lowland [Lowland]; Depressional [Pond, Sinkhole]; Muck; Mineral: W/ A-Horizon >10 cm

Concept Summary: This system of ponds and wetlands is found in the Interior Highlands of the Ozark, Ouachita, and Interior Low Plateau regions, and ranges north from the southern and central Appalachians to the northern Piedmont regions. Stands occur in basins of sinkholes or other isolated depressions on uplands. Soils are very poorly drained, and surface water may be present for

extended periods of time, rarely becoming dry. Water depth may vary greatly on a seasonal basis and may be a meter deep or more in the winter. Some examples become dry in the summer. Soils may be deep (100 cm or more), consisting of peat or muck, with parent material of peat, muck or alluvium. Ponds vary from open water to herb-, shrub-, or tree-dominated. Tree-dominated examples typically contain *Quercus* species, *Platanus occidentalis*, *Fraxinus pennsylvanica*, *Acer saccharinum*, or *Nyssa* species, or a combination of these. In addition, *Liquidambar styraciflua* may be present in southern examples. *Cephalanthus occidentalis* is a typical shrub component. The herbaceous layer is widely variable depending on geography.

Comments: Many of these ponds have their geologic origin as a more-or-less complete karst collapse feature. Some of them may display this geologic origin in a more explicit manner, with definite walls and exposed limestone or dolomite at the surface ("sinkholes"). Others are more subtle, and exist as more gentle depressions, with no exposed surface geology ("depression ponds"). This includes the "sagponds" of northwestern Georgia and adjacent Alabama. Rare examples in the Ridge and Valley of Georgia (Coosa Valley) are included here. These occur on limestones or dolomites of the Chickamauga Group. Matt Elliott (pers. comm.): "I would put Ridge and Valley sagponds in with Interior Highlands ponds rather than Piedmont, as they are essentially karst features. R&V sagponds are generally pretty rare but are common in parts of Bartow County, Georgia, and a few other places. The shallower ones are dominated by willow oak, the deeper ones *Nyssa biflora*. On the Cumberland Plateau, the ones I have seen usually have sweetgum and *Nyssa sylvatica*, but I think willow oak and possibly *Nyssa biflora* might occur in some of the deeper ones. A lot of the plateau ponds seem more like swales than deep ponds, but they still may be related to underlying karst features. The Ridge and Valley sagponds may be somewhat different from those on the plateau - often deeper and with even more Coastal Plain elements; it also includes sinkhole ponds of northern New Jersey (K. Strakosch-Walz pers. comm.) and possibly ponds of the Ridge and Valley in Pennsylvania. These are very similar to Shenandoah sinkhole ponds of Virginia and are in Maryland as well (L. Sneddon pers. comm.). The only documented occurrence in Pennsylvania is the Maple Hills sinkhole in Lycoming County; "there are plenty of other sinkholes in Pennsylvania, but they have not been associated with any specific plant community" (G. Podnieszinski pers. comm. 2010).

DISTRIBUTION

Range: This system is found from the Ozark and Ouachita mountains east to the southern and central Appalachians and the northern Piedmont regions (?), including the unglaciated Interior Low Plateau and Ridge and Valley. It ranges from Missouri, West Virginia, Pennsylvania, and Delaware south to Arkansas, Alabama and Georgia.

Divisions: 202:C

TNC Ecoregions: 38:C, 39:C, 44:C, 50:C, 59:C, 61:C

Nations: US

Subnations: AL, AR, DE, GA, IL, IN, KY, MD, MO, NC, NJ, OH, PA, TN, VA, WV

Map Zones: 44:C, 47:C, 48:C, 49:C, 53:C, 57:C, 61:C, 62:P, 64:P

USFS Ecomap Regions: 221F:CC, 221H:CC, 221J:CC, 223A:CC, 223D:CC, 223E:CC, 223F:CC, 231C:CC, 231D:CC, M221A:CC, M223A:CC, M231A:CC

CONCEPT

Associations:

- (*Quercus palustris*) / *Panicum rigidulum* var. *rigidulum* - *Panicum verrucosum* - *Eleocharis acicularis* Herbaceous Vegetation (CEGL007858, G1)
- *Carex barrattii* Herbaceous Vegetation (CEGL007857, G1)
- *Quercus palustris* - *Quercus bicolor* - (*Liquidambar styraciflua*) Mixed Hardwood Forest (CEGL002432, G3G4)
- *Quercus lyrata* / *Betula nigra* / *Pleopeltis polypodioides* ssp. *michauxiana* Forest (CEGL004975, G1)
- *Brasenia schreberi* Eastern Herbaceous Vegetation (CEGL004527, G4?)
- *Pontederia cordata* - *Sagittaria graminea* - *Sagittaria latifolia* Semipermanently Flooded Herbaceous Vegetation (CEGL004986, G1G2Q)
- *Quercus lyrata* - *Quercus* (*palustris*, *phellos*) - *Liquidambar styraciflua* - (*Populus heterophylla*) Forest (CEGL004421, G2G3)
- *Typha latifolia* Southern Herbaceous Vegetation (CEGL004150, G5)
- *Quercus bicolor* - *Fraxinus pennsylvanica* / *Carex* spp. Forest (CEGL004422, G1G2)
- *Eleocharis microcarpa* - *Juncus repens* - *Rhynchospora corniculata* - (*Mecardonia acuminata*, *Proserpinaca* spp.) Herbaceous Vegetation (CEGL004748, G2G3)
- *Nelumbo lutea* Herbaceous Vegetation (CEGL004323, G4?)
- *Cephalanthus occidentalis* - (*Salix nigra*, *Quercus lyrata*) Karst Depression Shrubland (CEGL008439, G1Q)
- *Quercus alba* - *Nyssa sylvatica* Sandstone Ridgetop Depression Forest (CEGL008440, G2Q)
- *Quercus palustris* Pond Forest (CEGL007809, G2)
- *Scirpus cyperinus* - *Panicum rigidulum* - *Rhynchospora corniculata* - (*Dulichium arundinaceum*) Herbaceous Vegetation (CEGL004719, G2G3)
- *Orontium aquaticum* - *Schoenoplectus subterminalis* - *Eriocaulon aquaticum* Herbaceous Vegetation (CEGL007859, G1)
- *Quercus phellos* Seasonally Flooded Ozark Pond Forest (CEGL007402, GNR)
- *Quercus alba* - *Nyssa sylvatica* Seasonally Flooded Forest (CEGL008473, GNR)
- *Quercus lyrata* Pond Forest (CEGL004642, G1G3)
- *Nyssa aquatica* / *Cephalanthus occidentalis* Pond Forest (CEGL004712, G1?)
- *Nyssa biflora* / *Cephalanthus occidentalis* - *Lyonia lucida* Sagpond Forest (CEGL004116, G1G2)

- *Acer (rubrum, saccharinum)* - *Fraxinus pennsylvanica* / *Ilex verticillata* / *Osmunda regalis* Forest (CEGL006630, GNR)
- *Ceratophyllum demersum* - *Stuckenia pectinata* Herbaceous Vegetation (CEGL004528, G4G5)
- *Scirpus cyperinus* - *Dulichium arundinaceum* / *Sphagnum* spp. Herbaceous Vegetation (CEGL004134, G1Q)
- *Panicum hemitomon* - *Dulichium arundinaceum* Herbaceous Vegetation (CEGL004126, G1)
- *Liquidambar styraciflua* - *Acer rubrum* / *Carex* spp. - *Sphagnum* spp. Forest (CEGL007388, G2G3Q)
- *Quercus palustris* - (*Quercus bicolor*) / *Carex crinita* / *Sphagnum* spp. Forest (CEGL002406, G3?)
- *Carex aquatilis* - *Dulichium arundinaceum* Herbaceous Vegetation (CEGL008542, G1?)
- *Sparganium americanum* - (*Sparganium erectum* ssp. *stoloniferum*) - *Epilobium leptophyllum* Herbaceous Vegetation (CEGL004510, G3?)
- *Saccharum baldwinii* - *Calamagrostis coarctata* - *Panicum rigidulum* - *Rhynchospora capitellata* Herbaceous Vegetation (CEGL004750, G2G3)
- *Ludwigia peploides* Herbaceous Vegetation (CEGL007835, G4G5)
- *Cephalanthus occidentalis* / *Hibiscus moscheutos* ssp. *moscheutos* Depression Pond Shrubland (CEGL004742, G3?)
- *Dasiphora fruticosa* ssp. *floribunda* / *Rhynchospora capillacea* - *Scleria verticillata* Shrub Herbaceous Vegetation (CEGL006356, G1)
- *Vaccinium oxycoccus* - (*Vaccinium macrocarpon*) / *Rhynchospora alba* - *Drosera rotundifolia* / *Sphagnum* spp. Dwarf-shrubland (CEGL007856, G2)
- *Quercus phellos* - *Liquidambar styraciflua* / *Chasmanthium laxum* Cumberland / Southern Ridge and Valley Forest (CEGL008441, G3)
- *Phalaris arundinacea* Eastern Herbaceous Vegetation (CEGL006044, GNA)
- *Carex comosa* - *Carex decomposita* - *Dulichium arundinaceum* - *Lycopus rubellus* Herbaceous Vegetation (CEGL002413, G3G4)
- *Platanus occidentalis* - *Fraxinus pennsylvanica* - *Ulmus americana* / *Cornus sericea* Forest (CEGL006901, G2G3)
- *Fraxinus pennsylvanica* - *Acer saccharinum* - *Quercus bicolor* / *Boehmeria cylindrica* Forest (CEGL006634, GNR)
- *Boltonia asteroides* var. *asteroides* - *Symphytotrichum racemosum* - *Mentha arvensis* Herbaceous Vegetation (CEGL006900, G1G2)
- *Leersia oryzoides* - *Boehmeria cylindrica* - *Ranunculus flabellaris* Herbaceous Vegetation (CEGL006903, GNR)
- *Nuphar advena* - *Nymphaea odorata* Herbaceous Vegetation (CEGL002386, G4G5)
- *Salix nigra* - *Acer (rubrum, saccharinum)* / *Alnus serrulata* - *Cephalanthus occidentalis* Forest (CEGL007703, G5)
- *Carex jorii* - *Eleocharis tenuis* var. *verrucosa* - *Juncus* spp. - *Panicum rigidulum* Interior Highlands Channel Scar Depression Wooded Herbaceous Vegetation (CEGL007116, G2?)

High-ranked species: *Aureolaria patula* (G3), *Boltonia montana* (G1G2), *Canis rufus* (G1Q), *Carex decomposita* (G3G4), *Fimbristylis perpusilla* (G2), *Glyptemys muhlenbergii* (G3), *Helenium virginicum* (G3), *Isoetes virginica* (G1), *Muhlenbergia torreyana* (G3), *Myotis austroriparius* (G3G4), *Platanthera leucophaea* (G2G3), *Potamogeton hillii* (G3), *Potamogeton tennesseensis* (G2G3), *Schoenoplectus hallii* (G2G3), *Scirpus ancistrochaetus* (G3)

Environment: Examples of this system occur in basins of sinkholes or other isolated depressions on uplands. Soils are very poorly drained, and surface water may be present for extended periods of time, rarely becoming dry. Water depth may vary greatly on a seasonal basis, and may be a meter deep or more in the winter. Some examples become dry in the summer. Soils may be deep (100 cm or more), consisting of peat or muck, with parent material of peat, muck or alluvium.

Vegetation: Ponds vary from open water to herb-, shrub-, or tree-dominated types. Tree-dominated examples typically contain *Quercus* species, *Platanus occidentalis*, *Fraxinus pennsylvanica*, *Acer saccharinum*, or *Nyssa* species, or a combination of these. In addition, *Liquidambar styraciflua* may be present in southern examples. *Cephalanthus occidentalis* is a typical shrub component. The herbaceous layer is widely variable depending on geography.

Dynamics: Water depth may vary greatly on a seasonal basis, and may be a meter deep or more in the winter. Some examples become dry in the summer.

SOURCES

References: Comer et al. 2003, Evans 1991, Eyre 1980, M. Elliott pers. comm., Wharton 1978

Version: 26 Jan 2006

Stakeholders: East, Midwest, Southeast

Concept Author: M. Pyne, S. Menard, D. Faber-Langendoen

LeadResp: Midwest

6. ROCK VEGETATION

6.B. Mediterranean, Temperate & Boreal Rock Vegetation

6.B.2. TEMPERATE & BOREAL CLIFF, SCREE & OTHER ROCK VEGETATION

6.B.2.Na. Eastern North American Temperate Cliff, Scree & Rock Vegetation

M111. EASTERN NORTH AMERICAN CLIFF & ROCK VEGETATION

G106. Eastern North American Temperate Cliff

CES202.689 CENTRAL INTERIOR ACIDIC CLIFF AND TALUS

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Barren

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland

Concept Summary: This system is found primarily in the Interior Highlands, including the Ozarks, Ouachita, and Interior Low Plateau ecoregions, extending marginally north and west along the Missouri and Mississippi rivers. Sandstone outcrops and talus ranging from moist to dry typify this system. It is typically sparsely vegetated; however, on moister sites with more soil development, several fern species and sedges (*Carex* spp.) can establish. Wind and water erosion are the major dynamic processes influencing this system.

Comments: In Kentucky, this system covers the sandstone cliffs of the Shawnee Hills (Interior Low Plateau). In Illinois, one exemplary example is the "Garden of the Gods" in the Shawnee National Forest.

DISTRIBUTION

Range: This system is found primarily in the Interior Highlands, including the Ozark, Ouachita, and Interior Low Plateau ecoregions. It extends marginally into the Central Tallgrass Prairie Ecoregion along the Missouri and Mississippi rivers.

Divisions: 202:C

TNC Ecoregions: 36:C, 38:C, 39:C, 44:C

Nations: US

Subnations: AR, IA?, IL, IN, KY, MO, TN

Map Zones: 43:P, 44:C, 47:C, 48:C, 49:C, 53:C

CONCEPT

Associations:

- Chert Ozark Moist Cliff Sparse Vegetation (CEGL002288, G2G3)
- *Osmunda cinnamomea* - *Rhynchospora capitellata* - *Heuchera parviflora* var. *puberula* - *Xyris jupicai* Herbaceous Vegetation (CEGL007837, G1Q)
- (*Hydrangea arborescens*, *Ribes cynosbati*) / *Deschampsia flexuosa* - *Dryopteris marginalis* - *Dennstaedtia punctilobula* Shrubland (CEGL007820, G2?)
- (*Carex interior*, *Carex lurida*) - *Carex leptalea* - *Parnassia grandifolia* - *Rhynchospora capillacea* Herbaceous Vegetation (CEGL002404, G2G3)
- Chert Ozark Dry Cliff Sparse Vegetation (CEGL002285, G3?)
- Sandstone Dry Cliff Sparse Vegetation (CEGL002045, G4G5)
- Sandstone Midwest Moist Cliff Sparse Vegetation (CEGL002287, G4G5)
- Igneous Ozark Moist Cliff Sparse Vegetation (CEGL002289, G4Q)
- Igneous Ozark Dry Cliff Sparse Vegetation (CEGL002286, G4)
- Igneous Ozark Talus Sparse Vegetation (CEGL005203, G4)
- Sandstone Interior Highlands Talus Sparse Vegetation (CEGL002309, G4G5)

High-ranked species: *Heuchera parviflora* var. *puberula* (G4T3T4), *Parnassia grandifolia* (G3), *Quercus acerifolia* (G1)

Environment: Sandstone outcrops and talus ranging from moist to dry typify this system.

Vegetation: This system is typically sparsely vegetated; however, on moister sites with more soil development, several fern species and sedges (*Carex* spp.) can establish. Some taxa that could be present include *Ribes cynosbati*, *Deschampsia flexuosa*, *Dryopteris marginalis*, and *Dennstaedtia punctilobula*, as well as *Carex interior*, *Carex lurida*, *Carex leptalea*, *Parnassia grandifolia*, *Rhynchospora capillacea*, *Osmunda cinnamomea*, *Rhynchospora capitellata*, *Heuchera parviflora* var. *puberula*, and *Xyris jupicai* on wetter sites.

Dynamics: Wind and water erosion are the major dynamic processes influencing this system.

SOURCES

References: Comer et al. 2003, Evans 1991

Version: 17 Apr 2006

Concept Author: S. Menard, T. Foti, R. Evans

Stakeholders: East, Midwest, Southeast

LeadResp: Midwest

CES202.690 CENTRAL INTERIOR CALCAREOUS CLIFF AND TALUS

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Barren

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland

Concept Summary: This system is found primarily in non-Appalachian portions of the Central Interior Division. It ranges from the Ouachitas east to the Cumberland mountains and north into the Western Allegheny Plateau and Lake states. Limestone and dolomite outcrops and talus distinguish this system. Examples range from moist to dry and from sparsely to moderately well-vegetated. Woodland species such as *Thuja occidentalis* can establish along the ridgetops. Understory species can range from grassland species, such as *Andropogon gerardii* on drier slopes, to more mesic species in areas with higher moisture and more soil development. Wind and water erosion along with fire are the primary natural dynamics influencing this system. Some associations included here are rocky openings in forest stands, sometimes with moisture present from groundwater seepage. Also included are wet and dry cliffs. The flora of these wetter examples may include (across the broad range of the system) *Aconitum noveboracense*, *Adiantum capillus-veneris*, *Adoxa moschatellina*, *Aquilegia canadensis*, *Asplenium rhizophyllum*, *Boehmeria cylindrica*, *Chrysosplenium iowense*, *Cystopteris bulbifera*, *Cystopteris bulbifera*, *Dichanthelium depauperatum*, *Heuchera americana*, *Heuchera americana* var. *hirsuticaulis*, *Heuchera villosa* var. *arkansana*, *Hydrangea arborescens*, *Impatiens pallida*, *Lobelia siphilitica*, *Toxicodendron radicans*, and *Woodsia obtusa*.

Comments: Similar examples in the driftless region of Minnesota, Wisconsin, Iowa and Illinois should be considered part of Paleozoic Plateau Bluff and Talus (CES202.704).

DISTRIBUTION

Range: This system is found primarily in non-Appalachian portions of the Central Interior Division.

Divisions: 201:?, 202:C, 205:P

TNC Ecoregions: 36:C, 38:C, 39:C, 44:C, 45:C, 46:C, 47:?, 48:C, 49:C

Nations: US

Subnations: AR, IA, IL, IN, KY?, MI, MN, MO, NY, OH, OK, PA, TN, WI

Map Zones: 41:?, 42:P, 43:P, 44:C, 47:C, 48:C, 49:P, 50:C, 51:C, 52:C, 53:C, 61:C, 62:C, 63:C, 64:C

USFS Ecomap Regions: 222M:CC

CONCEPT

Associations:

- Limestone - Dolostone Midwest Dry Cliff Sparse Vegetation (CEGL002291, G4G5)
- Limestone - Dolostone Talus Sparse Vegetation (CEGL002308, G4G5)
- *Acer saccharum* - *Tilia americana* - *Fraxinus americana* / *Ostrya virginiana* / *Geranium robertianum* Woodland (CEGL005058, G3G5)
- *Rhus aromatica* - *Celtis tenuifolia* / *Carex eburnea* Shrubland (CEGL004393, G3)
- Limestone - Dolostone Midwest Moist Cliff Sparse Vegetation (CEGL002292, G4G5)
- *Thuja occidentalis* / *Carex eburnea* - *Pellaea atropurpurea* Woodland (CEGL002596, G2G3)
- *Hydrangea arborescens* / *Heuchera (americana* var. *hirsuticaulis*, *villosa* var. *arkansana*) - *Aquilegia canadensis* Shrubland (CEGL007819, G3?)
- *Schizachyrium scoparium* - *Sporobolus compositus* var. *compositus* - *Rudbeckia fulgida* var. *fulgida* Wooded Herbaceous Vegetation (CEGL004078, G2)
- *Schizachyrium scoparium* - *Bouteloua curtipendula* Bedrock Bluff Herbaceous Vegetation (CEGL002245, G3G4)
- Small Eroding Bluffs Midwestern Sparse Vegetation (CEGL002315, GNR)
- *Quercus muehlenbergii* - (*Juniperus virginiana* var. *virginiana*) Unglaciated Bluff Woodland (CEGL004267, G2G3)
- *Hydrangea arborescens* / *Impatiens (capensis, pallida)* - *Heuchera villosa* Shrubland (CEGL004708, G3)
- *Impatiens pallida* - *Cystopteris bulbifera* - *Adoxa moschatellina* - (*Chrysosplenium iowense*, *Aconitum noveboracense*) Herbaceous Vegetation (CEGL002387, G2)
- *Adiantum capillus-veneris* - *Boehmeria cylindrica* - *Lobelia siphilitica* Herbaceous Vegetation (CEGL004728, G2G3)
- *Andropogon gerardii* - *Chasmanthium latifolium* - *Amsonia tabernaemontana* var. *salicifolia* Herbaceous Vegetation (CEGL004739, G2G3)
- (*Hydrangea arborescens*, *Toxicodendron radicans*) / *Heuchera americana* - (*Dichanthelium depauperatum*, *Woodsia obtusa*) Shrubland (CEGL004395, G3?)
- *Thuja occidentalis* Cliff Woodland (CEGL002451, G3)

High-ranked species: *Aconitum noveboracense* (G3), *Catinella gelida* (G1), *Chrysosplenium iowense* (G3?), *Euchemotrema hubrichti* (G1G3), *Heuchera villosa* var. *arkansana* (G5T3Q), *Pellaea glabella* ssp. *missouriensis* (G5T1T2), *Polymnia cossatotensis* (G1)

Environment: Limestone and dolomite outcrops and talus distinguish this system.

Vegetation: Examples range from moist to dry and from sparsely to moderately well-vegetated. Woodland species such as *Thuja occidentalis* can establish along the ridgetops. Understory species can range from grassland species, such as *Andropogon gerardii* on drier slopes, to more mesic species in areas with higher moisture and more soil development. The flora of some moister examples (e.g., rocky openings in forest stands, with moisture present from groundwater seepage as well as wet cliffs) includes (across the broad range of the system) *Aconitum noveboracense*, *Adiantum capillus-veneris*, *Adoxa moschatellina*, *Aquilegia canadensis*, *Asplenium rhizophyllum*, *Boehmeria cylindrica*, *Chrysosplenium iowense*, *Cystopteris bulbifera*, *Dichanthelium depauperatum*, *Heuchera americana*, *Heuchera americana* var. *hirsuticaulis*, *Heuchera villosa* var. *arkansana*, *Hydrangea arborescens*, *Impatiens pallida*, *Lobelia siphilitica*, *Toxicodendron radicans*, and *Woodsia obtusa*.

Dynamics: Wind and water erosion along with fire are the primary natural dynamics influencing this system.

SOURCES

References: Comer et al. 2003, Evans 1991, Eyre 1980, Vanderhorst pers. comm.

Version: 01 Feb 2007

Stakeholders: East, Midwest, Southeast

Concept Author: S. Menard

LeadResp: Midwest

CES202.309 CUMBERLAND ACIDIC CLIFF AND ROCKHOUSE

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Barren

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland

Diagnostic Classifiers: Cliff (Substrate); Acidic Soil

Concept Summary: This sandstone cliff ecological system is found in the Cumberland Plateau and Mountain regions of the southeastern United States. Examples are extremely steep or vertical rock faces exposed along bluffs often associated with rivers. The aspect is variable but best developed on south- and west-facing sites. Plants are infrequent due to the lack of crevices capable of accumulating soil, the highly acidic nature of the bedrock, and the frequent weathering and erosion of the substrate. Lichen cover may be extensive in places, especially on the more exposed portions. These cliffs are also prone to harsh climatic conditions; frequent disturbances include drought stress and wind and storm damage. As a result, examples are characterized by sparse herbaceous cover and few, if any, trees. Vegetation consists of scattered individuals of *Asplenium montanum*, *Silene rotundifolia*, and other species rooted in crevices and erosion pockets. In some parts of its range, this system is the primary or sole habitat for rare endemic species, such as *Minuartia cumberlandensis* and *Ageratina luciae-brauniae*. This system includes a mosaic of cavelike features (often called "rockhouses") and associated sandstone box canyons in the western Appalachian foothills regions of Kentucky, Alabama, West Virginia, and possibly southeastern Ohio. Where present, the rockhouses are a prominent and diagnostic feature of the system.

Comments: It is unclear whether or not this system should range into the Interior Low Plateau. Also debatable is whether or not wet and dry cliffs should be included as well as the number of different physical settings possible. See also Southern Appalachian Montane Cliff and Talus (CES202.330).

DISTRIBUTION

Range: This system occurs in a limited area of the Cumberland Plateau of northern Alabama, northwestern Georgia, eastern Kentucky, eastern Tennessee, West Virginia, and possibly southwestern Virginia. It may occur in southeastern Ohio (Rockhouse 349) and in western Pennsylvania.

Divisions: 202:C

TNC Ecoregions: 50:C

Nations: US

Subnations: AL, GA, KY, OH?, PA?, TN, VA?, WV

Map Zones: 46:C, 47:C, 48:C, 53:C, 57:C, 62:?

CONCEPT

Associations:

- *Schizachyrium scoparium* - *Danthonia sericea* - *Liatris microcephala* - (*Eurybia surculosa*) Wooded Herbaceous Vegetation (CEGL004061, G3)
- *Osmunda cinnamomea* - *Rhynchospora capitellata* - *Thalictrum mirabile* Cumberland Seepage Cliff Herbaceous Vegetation (CEGL008432, G1G2Q)
- *Asplenium montanum* - *Heuchera parviflora* var. *parviflora* - *Silene rotundifolia* Sparse Vegetation (CEGL004392, G3G4)
- *Pinus virginiana* - *Pinus (rigida, echinata)* - (*Quercus prinus*) / *Vaccinium pallidum* Forest (CEGL007119, G3)
- *Heuchera parviflora* var. *parviflora* - *Trichomanes boschianum* - *Thalictrum mirabile* - (*Ageratina luciae-brauniae*, *Solidago albopilosa*) Herbaceous Vegetation (CEGL004301, G2)

High-ranked species: *Ageratina luciae-brauniae* (G3), *Aneides aeneus* (G3G4), *Canis rufus* (G1Q), *Carex misera* (G3), *Dodecatheon frenchii* (G3), *Fontigenes tartarea* (G2), *Heuchera alba* (G2Q), *Homaliadelphus sharpii* (G3?), *Hymenophyllum tayloriae* (G2), *Krigia montana* (G3), *Liatris helleri* (G2Q), *Liatris microcephala* (G3G4), *Mannia californica* (G3?), *Minuartia cumberlandensis* (G2G3), *Nardia lescurei* (G3?), *Neotoma magister* (G3G4), *Plagiochila austinii* (G3), *Plagiochila caduciloba* (G2), *Plagiochila eurphyllon* ssp. *echinata* (GNRT2), *Plagiochila sullivantii* var. *sullivantii* (G2T2), *Plagiochila virginica* var. *caroliniana* (G3T2), *Plagiochila virginica* var. *virginica* (G3T3), *Porella japonica* ssp. *appalachiana* (G5?T1), *Radula sullivantii* (G3), *Radula voluta* (G3), *Scopelophila cataractae* (G3), *Sedum nevi* (G3), *Tetradontium brownianum* (G3G4)

Environment: The rockhouses are the most unique and diagnostic feature of the system. These unusual geologic features are created by spray and rock-cracking from seasonal flowing waterfalls at the heads of canyons amidst thick layers of sandstone from the Pennsylvanian geologic period. The ceiling of the rockhouse may be 50 m tall, and they can be as much as 100 m deep (A. Weakley pers. comm. 2006). They require sufficient flowing water and freezing and thawing to weather the thick beds of sandstone. These conditions seem to be restricted to the western margin of the Appalachian Plateau.

Vegetation: Examples of this system usually include a vegetational mosaic that includes hemlock bluffs, sandstone cliffs, or overhangs near the base of a cliff (often with a sandy area beneath the overhang which is shaded and protected from direct rainfall, as well as gladelike vegetation at the horizontal portion of the cliffs). The rockhouses in the southern parts of the range are habitats for rare vascular plant species such as *Minuartia cumberlandensis* and *Ageratina luciae-brauniae* and sometimes support populations of rare nonvascular plants as well.

SOURCES

References: Comer et al. 2003, Evans 1991, Eyre 1980, Weakley pers. comm.

Version: 05 May 2008

Stakeholders: East, Midwest, Southeast

Concept Author: R. Evans

LeadResp: Southeast

CES201.569 LAURENTIAN-ACADIAN ACIDIC CLIFF AND TALUS

Primary Division: Laurentian-Acadian (201)

Land Cover Class: Barren

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Ridge/Summit/Upper Slope; Cliff (Substrate); Talus (Substrate); Acidic Soil; Landslide

Concept Summary: This cliff system occurs at low to mid elevations, well below treeline, from New England west to the Great Lakes. It consists of vertical or near-vertical cliffs and the talus slopes below, formed on hills of granitic or otherwise acidic bedrock. Most of the substrate is dry and exposed, but small (occasionally large) areas of seepage are often present. Vegetation in seepage areas tends to be more well-developed and floristically different from the surrounding dry cliffs. The vegetation is patchy and often sparse, punctuated with patches of small trees (e.g., *Betula* and *Picea* spp.). Calciphilic species are absent. In north-facing or other sheltered settings where cold air accumulates at the bottom of slopes, a shrubland of heaths and reindeer lichens can develop. This system differs from the more southerly North-Central Appalachian Acidic Cliff and Talus (CES202.601) in the more boreal affinities of its flora, for example *Picea* spp. rather than *Juniperus virginiana*.

DISTRIBUTION

Range: This system is found in New England and adjacent Canada west to the Great Lakes.

Divisions: 201:C, 202:C

TNC Ecoregions: 47:C, 48:C, 61:C, 63:C

Nations: CA, US

Subnations: MA?, ME, MI, MN, NH, NY, VT, WI

Map Zones: 41:C, 50:C, 51:C, 63:C, 64:C, 65:C, 66:C

USFS Ecomap Regions: 212Jb:CCC, 212Jc:CCP, 212Jo:CCP, 212K:CC, 212Lb:CPP, 212M:CC, 212Q:CC, 212Ra:CCC, 212Sb:CCC, 212Sc:CCP, 212Sn:CCP, 212Sq:CCC, 212Tb:CCP, 212Tc:CCP, 212X:CP, 212Ya:CCC, 222Jc:CCC

CONCEPT

Associations:

- *Acer spicatum* - *Thuja occidentalis* - *Betula papyrifera* / *Taxus canadensis* Shrubland (CEGL005251, GNR)
- *Betula papyrifera* - *Picea glauca* / *Acer spicatum* - *Alnus viridis* / *Polypodium virginianum* Talus Shrubland (CEGL005252, GNR)
- *Picea rubens* / *Ribes glandulosum* Woodland (CEGL006250, G3G5)
- Basalt - Diabase Northern Open Talus Sparse Vegetation (CEGL005247, GNR)
- Granite - Metamorphic Talus Northern Sparse Vegetation (CEGL002409, G4G5)
- *Betula alleghaniensis* - *Quercus rubra* / *Polypodium virginianum* Woodland (CEGL006320, G3G5)
- Sandstone Dry Cliff Sparse Vegetation (CEGL002045, G4G5)
- Sandstone Midwest Moist Cliff Sparse Vegetation (CEGL002287, G4G5)
- *Polypodium (virginianum, appalachianum)* / Lichens Nonvascular Vegetation (CEGL006534, GNR)
- *Drosera rotundifolia* - *Viola* spp. Cliff Sparse Vegetation (CEGL006429, GNR)
- *Polypodium (virginianum, appalachianum)* Cliff Sparse Vegetation (CEGL006528, GNR)

- Igneous - Metamorphic Northern Dry Cliff Sparse Vegetation (CEGL002300, GNR)
- *Picea mariana* / *Ledum groenlandicum* - *Empetrum nigrum* / *Cladina* spp. Dwarf-shrubland (CEGL006268, G3G5)

High-ranked species: *Didymodon michiganensis* (G1G2), *Diplophyllum obtusatum* (G2?), *Porpidia diversa* (G2G3), *Porpidia herteliana* (G2G3), *Rubus vagus* (G2?Q), *Umbilicaria polyrhiza* (G3G4)

SOURCES

References: Comer et al. 2003, Eyre 1980, Gawler and Cutko 2010

Version: 05 Oct 2004

Concept Author: S.C. Gawler

Stakeholders: Canada, East, Midwest

LeadResp: East

CES201.570 LAURENTIAN-ACADIAN CALCAREOUS CLIFF AND TALUS

Primary Division: Laurentian-Acadian (201)

Land Cover Class: Barren

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland

Diagnostic Classifiers: Ridge/Summit/Upper Slope; Cliff (Substrate); Talus (Substrate); Alkaline Soil; Circumneutral Soil

Concept Summary: This cliff system occurs at low to mid elevations, well below treeline, from New England west to the Great Lakes. It consists of vertical or near-vertical cliffs and the talus slopes below, where weathering and/or bedrock chemistry produce circumneutral to calcareous pH and enriched nutrient availability. The vegetation is often sparse but may include patches of small trees. *Thuja occidentalis* may dominate on some cliffs (and reach very old ages, upwards of 1000 years). *Fraxinus* spp. and *Tilia americana* are woody indicators of the enriched setting.

DISTRIBUTION

Range: This system is found in scattered locations from New England and adjacent Canada west to the Great Lakes and northern Minnesota

Divisions: 201:C

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

Nations: US

Subnations: ME, MI, MN, NH, NY, VT, WI

Map Zones: 41:C, 50:C, 51:C, 63:C, 64:C, 66:C

USFS Ecomap Regions: 212Hl:CCC, 212Jb:CCC, 212Jc:CCP, 212Jo:CCP, 212Lb:CPP, 212Q:CC, 212Ra:CCC, 212Rc:CCC, 212Re:CCC, 212Sb:CCC, 212Sc:CCC, 212Sn:CCP, 212Sq:CCC, 212Tb:CCC, 212Tc:CCP, 212Tf:CCC, 212X:CP, 212Ya:CCP, 212Z:CC, 222Jc:CCC

CONCEPT

Associations:

- Limestone - Dolostone Midwest Dry Cliff Sparse Vegetation (CEGL002291, G4G5)
- Limestone - Dolostone Talus Sparse Vegetation (CEGL002308, G4G5)
- *Acer saccharum* - *Tilia americana* - *Fraxinus americana* / *Ostrya virginiana* / *Geranium robertianum* Woodland (CEGL005058, G3G5)
- Limestone - Dolostone Midwest Moist Cliff Sparse Vegetation (CEGL002292, G4G5)
- *Carex scirpoidea* Alkaline Cliff Sparse Vegetation (CEGL006526, GNR)
- *Thuja occidentalis* Carbonate Talus Woodland (CEGL005172, G3G4)
- *Thuja occidentalis* Cliff Woodland (CEGL002451, G3)

High-ranked species: *Catinella gelida* (G1), *Cephalozia affinis* (G2G3)

Vegetation: *Thuja occidentalis* may dominate on some cliffs (and reach very old ages, upwards of 1000 years). *Fraxinus* spp. and *Tilia americana* are woody indicators of the enriched setting (Kelly and Larson 1997).

SOURCES

References: Comer et al. 2003, Eyre 1980, Gawler and Cutko 2010, Kelly and Larson 1997

Version: 09 Jan 2003

Concept Author: S.C. Gawler

Stakeholders: East, Midwest

LeadResp: East

CES202.601 NORTH-CENTRAL APPALACHIAN ACIDIC CLIFF AND TALUS

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Barren

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland

Diagnostic Classifiers: Cliff (Substrate); Talus (Substrate); Temperate; Acidic Soil

Concept Summary: This system comprises sparsely vegetated to partially wooded cliffs and talus slopes in the Central Appalachians and adjacent ecoregions, occurring on rocks of acidic lithology and lacking any indicators of enriched conditions. This cliff system

occurs at low to mid elevations from central New England south to Virginia, and up to 1500 m in West Virginia. It consists of vertical or near-vertical cliffs and the talus slopes below, formed on hills of granitic, sandstone, or otherwise acidic bedrock. In some cases, especially in periglacial areas, this system may take the form of upper-slope boulderfields without adjacent cliffs, where talus forms from freeze/thaw action cracking the bedrock. Most of the substrate is dry and exposed, but small (occasionally large) areas of seepage are often present. Vegetation in seepage areas tends to be more well-developed and floristically different from the surrounding dry cliffs. The vegetation is patchy and often sparse, punctuated with patches of small trees that may form woodlands in places. *Juniperus virginiana* is a characteristic tree species, *Toxicodendron radicans* a characteristic woody vine, and *Polypodium virginianum* a characteristic fern. Within its range, *Pinus virginiana* is often present.

Comments: More complete data are needed to clarify the diagnostic differences between this system and similar systems to the north, south, and west: Laurentian-Acadian Acidic Cliff and Talus (CES201.569), Cumberland Acidic Cliff and Rockhouse (CES202.309), and Central Interior Acidic Cliff and Talus (CES202.689).

DISTRIBUTION

Range: This system is found from central New England and New York south to Virginia.

Divisions: 202:C

TNC Ecoregions: 49:C, 52:?, 59:C, 60:C, 61:C

Nations: US

Subnations: CT, MA, MD, NJ, NY, OH, PA, VA, WV

Map Zones: 60:C, 61:C, 62:C, 63:P, 64:P, 65:C

USFS Ecomap Regions: 221E:CC, M221A:CC, M221B:CC, M221D:CC

CONCEPT

Associations:

- *Betula lenta* - *Quercus prinus* / *Parthenocissus quinquefolia* Woodland (CEGL006565, G4)
- *Umbilicaria muehlenbergii* - *Lasallia papulosa* - (*Melanelia stygia*) Nonvascular Vegetation (CEGL004389, G2?)
- *Umbilicaria mammulata* Nonvascular Vegetation (CEGL004387, G4?)
- *Asplenium montanum* Central Appalachian Sandstone Sparse Vegetation (CEGL004391, GNR)
- Appalachian - Alleghenian Sandstone Dry Cliff Sparse Vegetation (CEGL006435, G4Q)
- *Betula alleghaniensis* - *Quercus rubra* / *Polypodium virginianum* Woodland (CEGL006320, G3G5)
- Sandstone Dry Cliff Sparse Vegetation (CEGL002045, G4G5)
- Sandstone Midwest Moist Cliff Sparse Vegetation (CEGL002287, G4G5)
- *Lasallia (papulosa, pensylvanica)* - *Dimelaena oreina* - (*Melanelia culbersonii*) Nonvascular Vegetation (CEGL004142, G5)
- *Lasallia papulosa* - *Stereocaulon glaucescens* - *Chrysothrix chlorina* Nonvascular Vegetation (CEGL004143, G1?)
- *Juniperus virginiana* / *Corydalis sempervirens* Cliff Sparse Vegetation (CEGL006422, G4)
- *Kalmia latifolia* - *Gaylussacia baccata* - *Vaccinium (angustifolium, pallidum)* - *Menziesia pilosa* Shrubland (CEGL003939, G2)

High-ranked species: *Acrobolbus ciliatus* (G3?), *Aneides aeneus* (G3G4), *Bryocromia vivicolor* (G1G2), *Bryum riparium* (G2G4), *Canis rufus* (G1Q), *Carex biltmoreana* (G3), *Carex misera* (G3), *Gymnoderma lineare* (G3), *Heuchera alba* (G2Q), *Hymenophyllum tayloriae* (G2), *Hypericum buckleii* (G3), *Krigia montana* (G3), *Leptohymenium sharpii* (G1), *Liatris helleri* (G2Q), *Liatris microcephala* (G3G4), *Lophocolea appalachiana* (G1G2Q), *Mannia californica* (G3?), *Marsupella emarginata* var. *latiloba* (G5T1T2), *Metzgeria fruticulosa* (G2Q), *Metzgeria furcata* var. *setigera* (G5T1), *Microtus chrotorrhinus carolinensis* (G4T3), *Nardia lescurii* (G3?), *Neotoma magister* (G3G4), *Plagiochila austinii* (G3), *Plagiochila caduciloba* (G2), *Plagiochila eurphyllon* ssp. *echinata* (GNRT2), *Plagiochila sullivantii* var. *spinigera* (G2T1), *Plagiochila sullivantii* var. *sullivantii* (G2T2), *Plagiochila virginica* var. *caroliniana* (G3T2), *Plagiomnium carolinianum* (G3), *Platyhypnidium pringlei* (G2G3), *Porella japonica* ssp. *appalachiana* (G5?T1), *Radula sullivantii* (G3), *Rhododendron vaseyi* (G3), *Saxifraga careyana* (G3), *Saxifraga caroliniana* (G3), *Scutellaria arguta* (G1?Q), *Sedum nevirii* (G3), *Tetradontium brownianum* (G3G4), *Thelypteris pilosa* var. *alabamensis* (G4T1), *Tsuga caroliniana* (G3)

Environment: This cliff system consists of vertical or near-vertical cliffs at low to mid elevations and the talus slopes below, formed on hills of granitic, sandstone, or otherwise acidic bedrock. Most of the substrate is dry and exposed, but small (occasionally large) areas of seepage are often present.

Vegetation: Vegetation in seepage areas tends to be more well-developed and floristically different from the surrounding dry cliffs. The vegetation is patchy and often sparse, punctuated with patches of small trees that may form woodlands in places. *Juniperus virginiana* is a characteristic tree species, *Toxicodendron radicans* a characteristic woody vine, and *Polypodium virginianum* a characteristic fern.

Dynamics: Periodic rockslides maintain the open character of this system. Fire is generally not an important factor, since steep slopes and rockslides prevent extensive vegetation development, limiting litter accumulation.

SOURCES

References: Comer et al. 2003, Eyre 1980

Version: 23 Jan 2012

Concept Author: S.C. Gawler

Stakeholders: East, Midwest, Southeast

LeadResp: East

CES202.603 NORTH-CENTRAL APPALACHIAN CIRCUMNEUTRAL CLIFF AND TALUS**Primary Division:** Central Interior and Appalachian (202)**Land Cover Class:** Barren**Spatial Scale & Pattern:** Small patch**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Upland**Diagnostic Classifiers:** Cliff (Substrate); Talus (Substrate); Temperate; Alkaline Soil

Concept Summary: This cliff system occurs at low to mid elevations from central New England south to Virginia and West Virginia. It consists of vertical or near-vertical cliffs and steep talus slopes where weathering and/or bedrock lithology produce circumneutral to calcareous pH and enriched nutrient availability. Substrates include limestone, dolomite and other rocks. The vegetation varies from sparse to patches of small trees, in places forming woodland or even forest vegetation. *Fraxinus* spp., *Tilia americana*, and *Staphylea trifolia* are woody indicators of the enriched setting. *Thuja occidentalis* may occasionally be present but is more characteristic of the related Laurentian-Acadian system to the north. The herb layer is typically not extensive but includes at least some species that are indicators of enriched conditions, e.g., *Impatiens pallida*, *Pellaea atropurpurea*, *Asplenium platyneuron*, or *Woodsia obtusa*.

DISTRIBUTION

Range: This system ranges from central New England and New York south to Virginia and West Virginia. The extent of the Virginia range remains to be documented, but it appears to be absent from the Southern Blue Ridge and Southern Ridge and Valley portions of the state.

Divisions: 202:C**TNC Ecoregions:** 52:C, 59:P, 60:?, 61:C**Nations:** US**Subnations:** CT, MA, MD, NH, NJ, NY, OH, PA, VA, VT, WV**Map Zones:** 53:C, 59:P, 61:C, 62:?, 63:P, 64:C, 65:C, 66:P**USFS Ecomap Regions:** 221Ae:CCP, 221Af:CCP, 221Ag:CCP, 221B:CC, 221D:CC, 221E:CC, M221A:CC, M221B:CC**CONCEPT****Associations:**

- *Tilia americana* - *Fraxinus americana* / *Acer pensylvanicum* - *Ostrya virginiana* / *Parthenocissus quinquefolia* - *Impatiens pallida* Woodland (CEGL008528, G3)
- *Acer saccharum* - *Tilia americana* - *Fraxinus americana* / *Ostrya virginiana* / *Geranium robertianum* Woodland (CEGL005058, G3G5)
- *Thuja occidentalis* / *Carex eburnea* - *Pellaea atropurpurea* Woodland (CEGL002596, G2G3)
- *Tilia americana* - *Fraxinus americana* / *Cornus florida* Woodland (CEGL006054, G3G5)
- *Pellaea atropurpurea* Cliff Sparse Vegetation (CEGL006527, GNR)
- *Acer saccharum* - *Quercus muehlenbergii* / *Carex platyphylla* Forest (CEGL006162, GNR)
- *Acer saccharum* - *Fraxinus americana* - *Juglans cinerea* / *Staphylea trifolia* / *Adlumia fungosa* Forest (CEGL006577, GNR)
- *Acer saccharum* - *Tilia americana* / *Staphylea trifolia* / *Dryopteris marginalis* - (*Impatiens pallida*) Forest (CEGL006471, G3G4)
- *Asplenium ruta-muraria* - *Pellaea atropurpurea* Sparse Vegetation (CEGL004476, G3G4)
- *Acer saccharum* - *Quercus muehlenbergii* Forest (CEGL005010, GNR)
- *Hydrangea arborescens* / *Sedum ternatum* - *Polypodium virginianum* Shrubland (CEGL006479, GNR)

High-ranked species: *Aneides aeneus* (G3G4), *Arabis patens* (G3), *Clematis addisonii* (G1?), *Heuchera americana* var. *hispida* (G5T3?), *Homaliadelphus sharpii* (G3?), *Leptohymerium sharpii* (G1), *Neotoma magister* (G3G4), *Paxistima canbyi* (G2), *Penstemon smallii* (G3), *Platyhypnidium pringlei* (G2G3), *Radula voluta* (G3), *Sedum nevii* (G3), *Silene virginica* var. *robusta* (G5T1Q), *Taxiphyllum alternans* (G3?), *Tortula ammonsiana* (G1G3)

SOURCES**References:** Comer et al. 2003, Eyre 1980, Vanderhorst pers. comm.**Version:** 05 May 2008**Concept Author:** S.C. Gawler**Stakeholders:** East, Midwest, Southeast**LeadResp:** East**G340. Eastern North American Talus & Bluff****CES202.704 PALEOZOIC PLATEAU BLUFF AND TALUS****Primary Division:** Central Interior and Appalachian (202)**Land Cover Class:** Steppe/Savanna**Spatial Scale & Pattern:** Small patch**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.); Upland**National Mapping Codes:** EVT 2517; ESLF 5430; ESP 1517

Concept Summary: This system is found in the driftless regions of southeastern Minnesota, southwestern Wisconsin, and northern Iowa and Illinois. This region was not glaciated like the surrounding areas and thus is predominated by rolling hills and bluff outcrops. This system is found primarily on bluffs and dry upper slopes along the Upper Mississippi River, although it can range into bordering regions such as the Baraboo Hills in Wisconsin. This system contains a mosaic of woodlands, savannas, prairies and sparsely vegetated limestone, dolomite, and/or sandstone outcrops, with occasional talus, especially algific talus. Soils range from thin to moderately deep and are moderately to excessively well-drained with a high mineral content. Woodlands consist of primarily a mixture of oak species such as *Quercus macrocarpa*, *Quercus rubra*, *Quercus muehlenbergii*, and *Quercus alba*. *Acer saccharum*, *Betula alleghaniensis*, and conifer species such as *Pinus* spp. and *Tsuga canadensis* may occur on more mesic and protected areas within this system. Prairie openings (also called "goat prairies") contain *Schizachyrium scoparium* and *Bouteloua curtipendula* with scattered *Juniperus virginiana*. Historically, fire was the most important dynamic maintaining these systems, however, fire suppression within the region has allowed more canopy cover and thus very few prairie openings remain. Algific talus harbors a number of unusual Pleistocene relict species, including plants and snails.

Comments: This system will need review from Minnesota, Wisconsin, and Iowa to make sure it is correctly characterized.

DISTRIBUTION

Range: This system is found within the Paleozoic Plateau (aka Driftless Region) of southeastern Minnesota, southwestern Wisconsin and northern Iowa and Illinois.

Divisions: 202:C

TNC Ecoregions: 46:C

Nations: US

Subnations: IA, IL, MN, WI

Map Zones: 42:C, 49:C, 50:C

USFS Ecomap Regions: 222L:CC

CONCEPT

Associations:

- *Tsuga canadensis* - *Acer saccharum* / (*Hepatica nobilis* var. *acuta*) Driftless Forest (CEGL002597, G2)
- *Schizachyrium scoparium* - *Bouteloua curtipendula* - *Muhlenbergia cuspidata* - *Symphotrichum sericeum* Alkaline Herbaceous Vegetation (CEGL002403, G2)
- *Schizachyrium scoparium* - *Bouteloua curtipendula* Bedrock Bluff Herbaceous Vegetation (CEGL002245, G3G4)
- *Pinus strobus* - (*Pinus resinosa*) Driftless Bluff Forest (CEGL002378, G2G3)
- *Pinus strobus* - *Abies balsamea* - *Betula alleghaniensis* Driftless Forest (CEGL002111, G2?)
- *Impatiens pallida* - *Cystopteris bulbifera* - *Adoxa moschatellina* - (*Chrysosplenium iowense*, *Aconitum noveboracense*) Herbaceous Vegetation (CEGL002387, G2)
- Maderate Cliff Sparse Vegetation (CEGL002293, G3?)
- *Quercus muehlenbergii* - *Quercus* (*alba*, *velutina*) - (*Juniperus virginiana* var. *virginiana*) Bluff Woodland (CEGL002144, G2G3)

SOURCES

References: Albert 1995b, Comer et al. 2003, Dunevitz pers. comm., Eyre 1980

Version: 05 Mar 2003

Concept Author: S. Menard

Stakeholders: Midwest

LeadResp: Midwest

G341. Great Lakes Cliff & Shore

CES201.025 GREAT LAKES ACIDIC ROCKY SHORE AND CLIFF

Primary Division: Laurentian-Acadian (201)

Land Cover Class: Barren

Spatial Scale & Pattern: Linear

Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland

Diagnostic Classifiers: Coast; Igneous Rock

Concept Summary: This system is found in the Great Lakes region of the U.S. and Canada where exposed bedrock dominates the shoreline. The bedrock may consist of acidic igneous, metamorphic, or sedimentary rock. Some bedrock shorelines are solid rock, others more cobbly or fragmented. The bedrock may be relatively horizontal or tilted, rounded or blocky, and sometimes cliff-like. The leading edge of the shoreline may be heavily impacted by wave action and winter ice movement, decreasing in effect with distance inland. Vegetation varies from sparse nonvascular vegetation to open-treed or shrubby communities along the same transect.

DISTRIBUTION

Range: Found in the Great Lakes region of the U.S. and Canada, where exposed bedrock dominates the shoreline.

Divisions: 201:C

TNC Ecoregions: 48:C

Nations: CA, US

Subnations: MI, MN, ON, WI

Map Zones: 41:C, 50:C, 51:C

USFS Ecomap Regions: 212Lb:CCC, 212Ra:CCP, 212Rd:CCP, 212Sb:CCC, 212Sc:CCC, 212Sn:CCC, 212Sq:CCC, 212Ya:CCC, 222Ud:CCC

CONCEPT

Associations:

- Non-alkaline Cobble - Gravel Great Lakes Shore Sparse Vegetation (CEGL002508, G2G3)
- Igneous - Metamorphic Bedrock Inland Lake Shore Sparse Vegetation (CEGL002301, G4G5)
- *Corylus cornuta* - *Amelanchier* spp. - *Prunus virginiana* Rocky Shrubland (CEGL005197, GNR)
- Granite - Metamorphic Bedrock Great Lakes Shore Sparse Vegetation (CEGL005216, GNR)
- Sandstone Bedrock Great Lakes Shore Sparse Vegetation (CEGL002507, G3G4)
- Granite - Metamorphic Great Lakes Shore Cliff Sparse Vegetation (CEGL005244, GNR)
- Sandstone Great Lakes Shore Cliff Sparse Vegetation (CEGL002503, G4G5)
- *Picea glauca* - *Abies balsamea* Basalt - Conglomerate Woodland (CEGL005214, GNR)

High-ranked species: *Didymodon michiganensis* (G1G2), *Porpidia diversa* (G2G3), *Porpidia herteliana* (G2G3), *Umbilicaria polyrhiza* (G3G4)

SOURCES

References: Albert et al. 1995, Comer et al. 2003

Version: 25 Mar 2003

Concept Author: D. Albert

Stakeholders: Canada, East, Midwest

LeadResp: Midwest

CES201.995 GREAT LAKES ALKALINE ROCKY SHORE AND CLIFF

Primary Division: Laurentian-Acadian (201)

Land Cover Class: Barren

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland

Concept Summary: This system is found in the Great Lakes region of the U.S. and Canada where exposed bedrock dominates the shoreline. The bedrock may consist of alkaline igneous, metamorphic, or sedimentary rocks. Some bedrock shorelines are solid rock, others more cobbly or fragmented. The bedrock may be relatively horizontal or tilted, rounded or blocky, and sometimes cliff-like. The leading edge of the shoreline may be heavily impacted by wave action and winter ice movement, decreasing in effect with distance inland. Alkaline rocky shores are predominantly dolostone when associated with the Niagaran Escarpment along the northern Lake Michigan and Lake Huron shorelines, perhaps best developed on Drummond Island and adjacent Ontario islands. Vegetation in these type is closely related to sparsely vegetated Great Lakes alvars. Alkaline basalts characterize these systems along portions of the Lake Superior shoreline, with a generally distinguishable flora from those on dolostone. Overall, vegetation varies from sparse nonvascular vegetation to open-treed or shrubby communities along the same transect.

DISTRIBUTION

Range: Found in the Great Lakes region of the U.S. and Canada, where exposed bedrock dominates the shoreline.

Divisions: 201:C

TNC Ecoregions: 48:C

Nations: CA, US

Subnations: MI, MN, ON, VT, WI

Map Zones: 41:C, 50:C, 51:C

USFS Ecomap Regions: 212Ha:CCP, 212Hf:CCC, 212Hl:CCC, 212Lb:CCC, 212Ra:CC?, 212Rc:CCC, 212Rd:CC?, 212Re:CCC, 212Sb:CCC, 212Sc:CC?, 212Sn:CCC, 212Te:CCC, 212Tf:CCC, 212Ya:C??

CONCEPT

Associations:

- Basalt - Diabase Great Lakes Shore Cliff Sparse Vegetation (CEGL005191, GNR)
- Basalt - Conglomerate Bedrock Great Lakes Shore Sparse Vegetation (CEGL005215, G4G5)
- *Dasiphora fruticosa* ssp. *floribunda* - *Myrica gale* Rich Shore Fen Shrubland (CEGL005275, G1G2)
- Limestone - Dolostone Great Lakes Shore Cliff Sparse Vegetation (CEGL002504, G4G5)
- Basalt - Diabase Cobble - Gravel Great Lakes Shore Sparse Vegetation (CEGL005250, G4G5)
- *Picea glauca* - *Abies balsamea* Basalt - Conglomerate Woodland (CEGL005214, GNR)
- *Calamagrostis canadensis* - *Carex viridula* - *Cladium mariscoides* - *Lobelia kalmii* Herbaceous Vegetation (CEGL005115, G1G2)
- Limestone Cobble - Gravel Great Lakes Shore Sparse Vegetation (CEGL005169, G2G3)
- *Dasiphora fruticosa* ssp. *floribunda* / *Clinopodium arkansanum* - *Argentina anserina* - *Primula mistassinica* Sparse Vegetation (CEGL002506, G3)

High-ranked species: *Catinella exile* (G2), *Mimulus glabratus* var. *michiganensis* (G5T1)

SOURCES**References:** Albert et al. 1995, Comer et al. 2003, Kost et al. 2007**Version:** 24 Mar 2003**Concept Author:** D. Albert**Stakeholders:** Canada, East, Midwest**LeadResp:** Midwest**6.B.2.Nc. Great Plains Cliff, Scree & Rock Vegetation****M116. GREAT PLAINS CLIFF, SCREE & ROCK VEGETATION****G567. Great Plains Cliff, Scree & Rock Vegetation****CES205.697 EASTERN GREAT PLAINS QUARTZITE ROCKY OUTCROP****Primary Division:** Eastern Great Plains (205)**Land Cover Class:** Barren**Spatial Scale & Pattern:** Small patch**Required Classifiers:** Natural/Semi-natural; Unvegetated (<10% vasc.); Upland

Concept Summary: This system is found along outcrops of Sioux quartzite in Minnesota and South Dakota. It is found on rocky, level or hilly areas within the Northern Tallgrass Prairie (TNC Ecoregion 35) of Minnesota and South Dakota. It is characterized by a mosaic of rocky outcrops that are sparsely vegetated with scattered succulents and other vegetation such as *Opuntia fragilis*, *Opuntia macrorhiza*, *Escobaria vivipara* (= *Coryphantha vivipara*), and *Lomatium orientale*, as well as *Selaginella rupestris*, *Talinum parviflorum*, *Woodsia ilvensis*, and a variety of spring- and summer-blooming annuals. Soil development is minimal and restricted to patches.

Comments: This system may not hold together as a system separate from a larger, surrounding system. These rocky outcrops were split from quartzite glades found in the Baraboo Hills region of Wisconsin (CES202.699). Distribution into Manitoba needs further review.

DISTRIBUTION**Range:** This system is found in a very restricted area within Minnesota and South Dakota along outcrops of Sioux quartzite.**Divisions:** 205:C**TNC Ecoregions:** 35:C**Nations:** CA?, US**Subnations:** MB?, MN, ND, SD**Map Zones:** 39:C, 40:?**USFS Ecomap Regions:** 251Ba:CCC**CONCEPT****Associations:**

- Quartzite - Granite Rock Outcrop Sparse Vegetation (CEGL002298, G3?)
- Boreal Glaciere Talus Sparse Vegetation (CEGL005243, G2G3)

Environment: Soil development is minimal. Most vegetation present grows in shallow, dry soil that collects in small depressions on sloping rock faces. The outcrops are composed primarily of Sioux quartzite, granite and gneiss. Extreme drought and great fluctuations in the temperature of the ground surface occur within this system (MNNHP 1993).

Vegetation: This system contains a sparse vegetation layer, with scattered succulents and many annuals, including *Opuntia fragilis*, *Opuntia macrorhiza*, *Escobaria vivipara* (= *Coryphantha vivipara*), and *Lomatium orientale*, as well as *Selaginella rupestris*, *Talinum parviflorum*, *Woodsia ilvensis*, and a variety of spring- and summer-blooming annuals (MNNHP 1993).

Dynamics: Fire appears to be important in maintaining this system. Trees and shrubs invade in the absence of fire. *Juniperus virginiana* is an invader throughout the range of this type, displacing the herbs, lichens, and mosses that characterize the system (MNNHP 1993).

SOURCES**References:** MNNHP 1993, Midwestern Ecology Working Group n.d.**Version:** 11 Apr 2007**Concept Author:** S.E. Menard**Stakeholders:** Canada, Midwest**LeadResp:** Midwest

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APPENDIX B:

**MAP REVIEW AND REVISION SUMMARY
FOR THE UPPER MIDWESTERN TERRESTRIAL HABITAT
CLASSIFICATION AND MAP**

20 May 2013

by

NatureServe

4600 North Fairfax Drive, 7th Floor
Arlington, VA 22203



Northeastern and Upper Midwestern Terrestrial Habitat Map Review and Revision Summary

System Name	Area in Final Map (ha)	Notes on Accuracy of Source Data	Actions Taken	Notes on Accuracy of the Final Map
Agriculture - Cultivated Crops and Irrigated Agriculture	46,224,637	Not reviewed	None	Mapping of agriculture is based primarily on the NLCD, and problematic in areas. The mapping of farmlands can be particularly difficult due to year-to-year changes in land management in the Midwest.
Agriculture - General	167	Not reviewed	None	Mapping of agriculture is based primarily on the NLCD, and problematic in areas. The mapping of farmlands can be particularly difficult due to year-to-year changes in land management in the Midwest.
Agriculture - Pasture/Hay	14,817,987	Not reviewed	Some changes in area due to reclassification of pixels previously mapped as natural systems (e.g. prairie) into or out of this type.	Mapping of agriculture is based primarily on the NLCD, and problematic in areas. The mapping of farmlands can be particularly difficult due to year-to-year changes in land management in the Midwest.
Allegheny-Cumberland Dry Oak Forest and Woodland	31,287	Possibly undermapped, but review of distribution did not identify obvious errors warranting revisions.	None	Possibly undermapped, but review of distribution did not identify obvious errors warranting revisions.
Appalachian (Hemlock)-Northern Hardwood Forest	644,786	Mapped outside its elevational and geographic range.	Restricted to elevations >1000 feet in Ecoregions 221 Fa and 221Fb, and removed entirely from Ecoregions 222H and 222I. Pixels classified as this types in those areas were reclassified as North-Central Interior Beech-Maple Forest.	Restrictions based on ecoregions and elevation helped restrict this type to more probable areas of occurrence, but such changes were by necessity overly simplistic.

Northeastern and Upper Midwestern Terrestrial Habitat Map Review and Revision Summary

System Name	Area in Final Map (ha)	Notes on Accuracy of Source Data	Actions Taken	Notes on Accuracy of the Final Map
Boreal Aspen-Birch Forest	1,100,887	See Eastern Hemi-Boreal Aspen Birch Forest; name changed to reflect hemi-boreal nature.	Name change, but no changes in mapped distribution.	see above
Boreal Jack Pine-Black Spruce Forest	0	Mapped outside its geographic range. Should be the new hemi-boreal type in some areas and Laurentian Jack Pine-Red Pine Forest in others.	Changed to Laurentian Jack Pine-Red Pine Forest if mapped in ecoregions 212K or 222.	This system can be difficult to distinguish from others with similar bio-physical affinities and spectral signatures; enforcing ecoregional restrictions improved mapping, but is an imperfect fix.
Boreal White Spruce-Fir-Hardwood Forest	0	Within the Midwest, all occurrence will be reclassified as Eastern Hemi-Boreal Mesic Balsam Fir-Spruce Hardwood Forest. See comments under that type for additional mapping notes.	Reclassified as Eastern Hemi-Boreal Mesic Balsam Fir-Spruce-Hardwood forest, unless mapped in ecoregion 222. If in 222, this was changed to Ruderal Forest.	No longer mapped in the Midwest.
Boreal-Laurentian Bog	3,377,257	This represents the Boreal Acidic Peatland Systems aggregate. It was not disaggregated when mapping this type. For the aggregate, the general distribution looks okay and we are not splitting a Laurentian-Acadian Acidic Peatland System from the Boreal at this time. There is some evidence that occurrences of this type are mapped as agriculture (Pasture or even Row Crop) in northwestern MN in some places when they should not be, but we are without efficient means to identify and fix those locations at this time.	None	This represents the Boreal Acidic Peatland Systems aggregate. It was not disaggregated when mapping this type. For the aggregate, the general distribution looks okay and we are not splitting a Laurentian-Acadian Acidic Peatland System from the Boreal at this time. There is some evidence that occurrences of this type are mapped as agriculture (Pasture or even Row Crop) in northwestern MN in some places when they should not be, but we are without efficient means to identify and fix those locations at this time.

Northeastern and Upper Midwestern Terrestrial Habitat Map Review and Revision Summary

System Name	Area in Final Map (ha)	Notes on Accuracy of Source Data	Actions Taken	Notes on Accuracy of the Final Map
Boreal-Laurentian Conifer Acidic Swamp and Treed Poor Fen	0	Not differentiated from Boreal-Laurentian Bog System in original map. It is not possible to split these two Systems using available resources.	None	Not mapped; difficult to capture given map resolution.
Boreal-Laurentian-Acadian Acidic Basin Fen	0	Not differentiated from Laurentian Acadian Freshwater Marsh System and Laurentian Acadian Wet Meadow Shrub Swamp in original map. It is not possible to split these two Systems using available resources.	None	Not mapped; difficult to capture given map resolution.
Central Appalachian Alkaline Glade and Woodland	0	System occurs as small patches on the landscape. Not mapped and difficult to capture given map resolution	None	Not mapped; difficult to capture given map resolution.
Central Appalachian Dry Oak-Pine Forest	3,439	Mapped outside its geographic range.	Changed to North-Central Interior Dry Oak Forest and Woodland if mapped in ecoregions 222 or 251.	This system can be difficult to distinguish from others with similar bio-physical affinities and spectral signatures; enforcing ecoregional restrictions improved mapping, but is an imperfect fix.
Central Appalachian Pine-Oak Rocky Woodland	783	Mapped outside its geographic range.	Changed to Northeastern Interior Dry-Mesic Forest if mapped in ecoregions 221Ef or 221Eg.	This system can be difficult to distinguish from others with similar bio-physical affinities and spectral signatures; enforcing ecoregional restrictions improved mapping, but is an imperfect fix.
Central Appalachian River Floodplain	112,177	Undermapped (should be in ecoregion 221E but is not).	Reclassified any floodplain systems mapped in 221E as this type (i.e. all North-Central Interior Floodplains became this).	The extent of the distribution is improved in accuracy, although it is possible that other floodplain systems occur in 221E and are now classified as this type.

Northeastern and Upper Midwestern Terrestrial Habitat Map Review and Revision Summary

System Name	Area in Final Map (ha)	Notes on Accuracy of Source Data	Actions Taken	Notes on Accuracy of the Final Map
Central Appalachian Stream and Riparian	0	Only mapped in southern Illinois, but this is outside its geographic range.	Reclassified this to South-Central Interior Large Floodplain in Illinois.	No longer mapped in the Midwest.
Central Interior Acidic Cliff and Talus	32,320	Given small mapped extent of this type, extensive review was not undertaken.	None	It is likely that small patches of this system are not captured by the map due to the minimum mapping size.
Central Interior Calcareous Cliff and Talus	325	Given small mapped extent of this type, extensive review was not undertaken.	None	It is likely that small patches of this system are not captured by the map due to the minimum mapping size.
Central Interior Highlands and Appalachian Sinkhole and Depression Pond	0	Not mapped; typically below minimum mapping unit size.	None	Not mapped due to patch sizes typically below the minimum mapping unit.
Central Interior Highlands Calcareous Glade and Barrens	176,464	Mapped in northern Illinois and northern Indiana outside its geographic range. Overmapped in northern Missouri and central Illinois.	Restricted distribution to ecoregions 221E, 221H, 223B, 223D, 223E, 223F. Where this was mapped elsewhere, we reclassified it as Ruderal Forest (if >10% tree cover) or Ruderal Upland - Old Field (if <10% tree cover).	Restrictions based on ecoregion helped restrict this type to more probable areas of occurrence, but such changes were by necessity overly simplistic.
Central Interior Highlands Dry Acidic Glade and Barrens	11,156	Mapped in northern Illinois and northern Indiana outside its geographic range. Overmapped in northern Missouri and central Illinois.	Restricted distribution to ecoregions 221E, 221H, 223B, 223D, 223E, 223F. Where this was mapped elsewhere, we reclassified it as Ruderal Forest (if >10% tree cover) or Ruderal Upland - Old Field (if <10% tree cover).	Restrictions based on ecoregion helped restrict this type to more probable areas of occurrence, but such changes were by necessity overly simplistic.

Northeastern and Upper Midwestern Terrestrial Habitat Map Review and Revision Summary

System Name	Area in Final Map (ha)	Notes on Accuracy of Source Data	Actions Taken	Notes on Accuracy of the Final Map
Central Mixedgrass Prairie	#N/A	Should not be mapped at all in the Midwest. The map review suggested that areas mapped as this were predominantly upland (old field, pasture, managed grasslands), although some areas appeared to be wetland.	Reclassified all occurrences in the Midwest to Ruderal Upland - Old Field.	No longer mapped in the Midwest.
Central Tallgrass Prairie	12,791	Significantly overmapped in Iowa and Missouri.	Reclassified all occurrences as Ruderal Upland - Old Field and then used Element Occurrence records from IA, IL, IN, and MO and the Minnesota digital prairie map to burn in this type.	It is likely that this system is now somewhat undermapped, as small occurrences not documented in natural heritage records are not accounted for. However, the current mapped distribution is much more accurate than the original mapping, especially in Minnesota.
Clearcut - Grassland/Herbaceous	380,494	Not reviewed	None	NA
Crosstimbers Oak Forest and Woodland	9,615	Distribution looked accurate in western Missouri, but this should not be mapped in northern Missouri.	Reclassified this to North Central Interior Dry Oak Forest and Woodland in ecoregion 251C.	Final distribution looks reasonably accurate.
Cumberland Acidic Cliff and Rockhouse	0	Pixels mapped as this type appear forested when reviewed in conjunction with aerial imagery.	Reclassified all pixels located within a forest matrix as South-Central Interior Mesophytic Forest (the matrix type), and retained only those pixels not within forested landscapes.	It is likely that some small patches of this system are not captured by the map due to the minimum mapping unit size.
Developed-High Intensity	361,759	Not reviewed	None	NA
Developed-Low Intensity	2,931,849	Not reviewed	None	NA
Developed-Medium Intensity	921,208	Not reviewed	None	NA
Developed-Open Space	5,447,939	Not reviewed	None	NA

Northeastern and Upper Midwestern Terrestrial Habitat Map Review and Revision Summary

System Name	Area in Final Map (ha)	Notes on Accuracy of Source Data	Actions Taken	Notes on Accuracy of the Final Map
East Gulf Coastal Plain Northern Loess Plain Oak-Hickory Upland	0	No changes recommended.	None	No longer mapped in the Midwest.
East Gulf Coastal Plain Northern Mesic Hardwood Slope Forest	0	Should not be mapped in the Midwest. Landfire data has this occurring in Missouri.	Reclassify occurrences of this in Missouri as Mississippi River Riparian Forest.	No longer mapped in the Midwest.
East Gulf Coastal Plain Northern Seepage Swamp	0	Not mapped. Some small seeps occur in Missouri but they tend to be under the surrounding upland forest canopy and not big enough to map.	None	Not mapped. Some small seeps occur in Missouri but they tend to be under the surrounding upland forest canopy and not big enough to map.
East-Central Texas Plains Riparian Forest	0	Should not be mapped in the Midwest.	Reclassified as Agriculture-Pasture/Hay.	No longer mapped in the Midwest.
Eastern Boreal Floodplain	22,323	Mapped outside geographic range and in areas outside floodplains.	Reclassified anything outside of ecoregions 212L, 212N, 212Jb, and 212Ya as Laurentian-Acadian Floodplain Forest. Attempted CART modeling to further restrict to floodplains, but models were unsuccessful in identifying variables to further restrict this type.	Mapping of this type would be improved by further restricting the distribution to well-delimited floodplains within its area of occurrence; we were unable to obtain consistent, high-accuracy data for floodplains during the course of this project and modeling using related variables proved unsuccessful. Users may want to consider the mapped distribution in conjunction with local maps of floodplain boundaries.
Eastern Great Plains Quartzite Rocky Outcrop	0	System occurs as small patches on the landscape. Not mapped and difficult to capture given map resolution	None	Not mapped; difficult to capture given map resolution

Northeastern and Upper Midwestern Terrestrial Habitat Map Review and Revision Summary

System Name	Area in Final Map (ha)	Notes on Accuracy of Source Data	Actions Taken	Notes on Accuracy of the Final Map
Eastern Great Plains Tallgrass Aspen Parkland	41,493	This is mistakenly mapped in floodplains. In northwestern Minnesota, this is sometime undermapped (called agriculture) but there is no efficient means of identifying and rectifying those errors.	Performed CART modeling to identify places where this is mapped in floodplains. Based on the model, we reclassified anything at elevations greater than 280 meters as North Central Interior Floodplain.	Our methods for excluding this type from floodplains were imperfect due to a lack of readily-available consistent, high-quality spatial data for floodplains.
Eastern Great Plains Wet Meadow, Prairie, and Marsh	109,850	General distribution looks okay, but this should not be mapped in 212 and 222Md.	Reclassified as Laurentian-Acadian Wet Meadow Shrub Swamp in ecoregion 212 and North-Central Interior Wet Meadow-Shrub Swamp in 222Md.	Restrictions based on ecoregion helped constrain this type to more probable areas of occurrence, but such changes were by necessity simplistic in nature.
Eastern Hemi-Boreal Aspen Birch Forest	1,100,887	Mapped outside its geographic range.	Changed to Laurentian-Acadian Northern Hardwoods Forest if mapped outside ecoregions 212L, 212M, 212Na, 212Nb, 212Y, 212J, 212S, or 212R.	This system can be difficult to distinguish from others with similar bio-physical affinities and spectral signatures; enforcing ecoregional restrictions improved mapping, but is somewhat simplistic. This was changed to Laurentian-Acadian Northern Hardwoods Forest across the board, but may actually represent NCI Dry-Mesic Oak Forest in places.
Eastern Hemi-boreal Dry Jack Pine-Red Pine Hardwood Forest	1	This system was not included in the original Landfire map.	All acres mapped as Laurentian-Acadian Dry Jack Pine Forest and Woodland were changed to this system in ecoregions 212L, 212M, 212Na, 212Nb, 212Nd, and 212Y.	This system is likely undermapped within the project area (see small extent).
Eastern Hemi-Boreal Dry-Mesic Pine-Black Spruce-Hardwood Forest	138,338	This system was not included in the original Landfire map.	Added to map by reclassifying Boreal Jack Pine-Black Spruce Forest to this type in areas outside ecoregions 212K and 222.	This system can be difficult to distinguish from others with similar bio-physical affinities and spectral signatures; enforcing ecoregional restrictions improved mapping, but is an imperfect fix.

Northeastern and Upper Midwestern Terrestrial Habitat Map Review and Revision Summary

System Name	Area in Final Map (ha)	Notes on Accuracy of Source Data	Actions Taken	Notes on Accuracy of the Final Map
Eastern Hemi-Boreal Mesic Balsam Fir-Spruce-Hardwood Forest	2,332,152	This system was not included in the original Landfire map, but Boreal White Spruce-Fir-Hardwood Forest will be reclassified to this type. That is mapped outside its geographic range, and also overmapped within its range. Some stands currently mapped as this type should probably be mapped as plantations, ruderal forest, or possibly wetlands, although we are unable to distinguish those at this time and thus will leave this mapped as the new hemi-boreal type.	Added to map by reclassifying Boreal White Spruce-Fir-Hardwood Forest to this type and reclassified as Ruderal Forest if mapped in ecoregion 222.	Ruderal forest was chosen as the overall best fit for areas where this system was mapped in ecoregion 222, but it is likely that some pixels changed to this type are wetlands or plantations.
Great Lakes Acidic Rocky Shore and Cliff	12,253	Mapped outside its geographic range, and some example in Minnesota and Michigan appear to be mines/tailings.	Reclassified as Central Interior Acidic Cliff and Talus if located in ecoregions but along the Great Lakes (i.e. if mapped outside 212Lb, 212Ya, 212Sb, 212Sn, 212Sq, 212Ra, 212Rd, 212Rc, 212Re, 212Te, 212Tf, 212Zc, 212Sc)	Restrictions based on ecoregion helped constrain this type to more probable areas of occurrence, but such changes were by necessity simplistic in nature. In spots, this is mapped where true land cover is mines/tailings, but we were unable to identify a feasible, systematic fix to address this issue.
Great Lakes Alkaline Rocky Shore and Cliff	0	Not mapped. These would be small patches that would be very difficult to distinguish from Great Lakes Acidic Rocky Shore.	None	Not mapped. These would be small patches that would be very difficult to distinguish from Great Lakes Acidic Rocky Shore.

Northeastern and Upper Midwestern Terrestrial Habitat Map Review and Revision Summary

System Name	Area in Final Map (ha)	Notes on Accuracy of Source Data	Actions Taken	Notes on Accuracy of the Final Map
Great Lakes Alvar	1,433	The original mapped extent seems problematic. Mapped in northern Wisconsin outside its geographic range (shouldn't be on Lake Superior). All pixels along the Door Peninsula should also be reclassified.	Reclassified as Laurentian-Acadian Freshwater Marsh in 212Ya and Laurentian-Acadian Alkaline-Conifer Swamp in 212Zc & 212Tf . Elsewhere, mapped occurrences were reclassified as ruderal forest and Element Occurrences were used to burn in this type .	Restrictions based on ecoregion helped constrain this type to more probable areas of occurrence, but such changes were by necessity simplistic in nature.
Great Lakes Dune	1,575	Overmapped; confused with beach along lakeshores, and old fields further inland.	Reclassified anything mapped as Great Lakes Dune to a new system, Great Lakes Sandy Beach if located within 90 meters of the Great Lakes shoreline. Reclassified all other mapped pixels as Great Lakes Dune, and then burned in known occurrences using Element Occurrence records and NPS vegetation maps at Sleeping Bear Dunes National Lakeshore and Pictured Rocks National Lakeshore.	It is likely that this system is now somewhat undermapped, as small occurrences not documented in natural heritage records or National Park Service maps are not accounted for. However, the current mapped distribution is much more accurate than the original mapping.
Great Lakes Freshwater Estuary and Delta	20,784	This looks okay although the St. Louis estuary is not mapped (it apparently was masked out by the Great Lakes water layer.)	None	In general, this looks okay, although the St. Louis estuary is not mapped (it appears to be masked out by the Great Lakes water layer) and adding it back to the map was beyond the scope of this project.
Great Lakes Sandy Beach	15,940	Not included in the original map.	Added this new system to the map by reclassifying habitat previously called Great Lakes Dune to be this system if within 90 meters of the lakeshore.	This system was added to the map in a somewhat simplistic manner. It is likely to be confused with Great Lakes Dune and Ruderal - Old Field in some areas.

Northeastern and Upper Midwestern Terrestrial Habitat Map Review and Revision Summary

System Name	Area in Final Map (ha)	Notes on Accuracy of Source Data	Actions Taken	Notes on Accuracy of the Final Map
Great Lakes Wet-Mesic Lakeplain Prairie	10,610	Mapped outside its geographic range and overmapped in southeast Michigan and northwest Ohio.	Reclassified as North-Central Interior Wet Meadow-Shrub Swamp if outside ecoregions 222Ua, 222Ub, 222Uc, or 222Ia. In areas where this occurs but is overmapped, we reclassified areas with >25% tree cover and clay/wet soils as North-Central Interior Flatwoods and areas with >25% tree cover and upland soils as North-Central Interior Dry-Mesic Oak Forest and Woodland.	Restrictions based on ecoregion helped constrain this type to more probable areas of occurrence, but such changes were by necessity simplistic in nature.
Great Lakes Wooded Dune and Swale	44,064	Distribution looks good; verified with vegetation map of Sleeping Bear Dunes National Seashore (okay match) and examination of northern lower MI.	None	Distribution looks good; verified with vegetation map of Sleeping Bear Dunes National Seashore (okay match) and examination of northern lower MI.
Great Plains Prairie Pothole	53,969	Distribution looks good. Probably somewhat overmapped in northwest Minnesota due to including too much area around the potholes, but difficult to systematically fix those errors..	None	Distribution looks good. Probably somewhat overmapped in northwest Minnesota due to including too much area around the potholes, but difficult to systematically fix those errors..
Harvested Forest-Grass Regeneration	94,313	Not reviewed	None	NA
Harvested forest-herbaceous regeneration	1,066,755	Not reviewed	None	NA
Interior Highlands Forested Acidic Seep	0	System occurs as small patches on the landscape. Not mapped and difficult to capture given map resolution	None	Not mapped; difficult to capture given map resolution.

Northeastern and Upper Midwestern Terrestrial Habitat Map Review and Revision Summary

System Name	Area in Final Map (ha)	Notes on Accuracy of Source Data	Actions Taken	Notes on Accuracy of the Final Map
Interior Low Plateau Seepage Fen	0	System occurs as small patches on the landscape. Not mapped and difficult to capture given map resolution	None	Not mapped; difficult to capture given map resolution.
Introduced Upland Vegetation - Perennial Grassland and Forbland	2,497	Not reviewed	None	NA
Introduced Upland Vegetation - Treed	4,320	Not reviewed	None	NA
Introduced Wetland Vegetation	37,053	Not reviewed	None	NA
Laurentian Acidic Rocky Outcrop	0	System occurs as small patches on the landscape. Not mapped and difficult to capture given map resolution	None	Not mapped; difficult to capture given map resolution.
Laurentian Jack Pine-Red Pine Forest	248,942	Mapped outside geographic range.	In 222, reclassified to be Laurentian Pine-Oak Forest. In 251 reclassified to be Managed Forest. Retained as originally mapped in 212Nc, 212K, 212J.	Restrictions based on ecoregion helped constrain this type to more probable areas of occurrence, but such changes were by necessity simplistic in nature.
Laurentian Pine-Oak Barrens	762,569	Mapped outside geographic range and of questionable accuracy in other areas (commonly confused with managed tree plantations).	Reclassified to Managed Tree Plantation in 251, 212L, 212Y, 212J, 212S, 212R (outside of Michigan only), and in Michigan if occurring in areas outside those mapped as Pine Barrens or Oak Pine Barrens in the Michigan presettlement vegetation map. All pixels mapped as Managed Tree Plantation within areas mapped as Pine Barrens and Oak Pine Barrens in the presettlement map were reclassified as Laurentian Pine-Oak Barrens in Michigan.	Restrictions based on ecoregion helped constrain this type to more probable areas of occurrence, but such changes were by necessity simplistic in nature. Integrating data from the Michigan pre-settlement map to refine the distribution should improve the map accuracy for this type, particularly in Michigan. In ecoregions 212Na and 212Nb some areas mapped as Laurentian Pine-Oak Barrens may actually be Managed Tree Plantations.

Northeastern and Upper Midwestern Terrestrial Habitat Map Review and Revision Summary

System Name	Area in Final Map (ha)	Notes on Accuracy of Source Data	Actions Taken	Notes on Accuracy of the Final Map
Laurentian-Acadian Acidic Cliff and Talus	0	System occurs as small patches on the landscape. Not mapped and difficult to capture given map resolution	None	Not mapped; difficult to capture given map resolution.
Laurentian-Acadian Alkaline Conifer-Hardwood Swamp	2,175,854	General distribution looks good. Possibly overmapped but we didn't see any clear problems in areas we reviewed.	None	General distribution looks good. Possibly overmapped but we didn't see any clear problems in areas we reviewed.
Laurentian-Acadian Alkaline Fen	0	System occurs as small patches on the landscape. Not mapped and difficult to capture given map resolution	None	Not mapped; difficult to capture given map resolution.
Laurentian-Acadian Calcareous Cliff and Talus	0	Not mapped and difficult to capture given map resolution / difficult to distinguish from Laurentian Acadian Acidic Cliff and Talus.	None	Not mapped; difficult to capture given map resolution. / difficult to distinguish from Laurentian Acadian Acidic Cliff and Talus.
Laurentian-Acadian Floodplain Forest	149,465	Mapped outside its geographic range as well as outside floodplains.	Reclassified anything outside of 212 or in 212L, 212N, 212Jb, and 212Ya as North-Central Interior Floodplain. Performed CART modeling to identify places with this is mapped outside of floodplains. Based on the model results, we reclassified anything with a stream distance > 350 meters as Laurentian-Acadian Alkaline Conifer-Hardwood Swamp.	Our methods for excluding this type from floodplains were imperfect due to a lack of readily-available consistent, high-quality spatial data delimiting floodplains. Restrictions based on ecoregion helped constrain this type to more probable areas of occurrence, but such changes were by necessity simplistic in nature.

Northeastern and Upper Midwestern Terrestrial Habitat Map Review and Revision Summary

System Name	Area in Final Map (ha)	Notes on Accuracy of Source Data	Actions Taken	Notes on Accuracy of the Final Map
Laurentian-Acadian Freshwater Marsh	1,379	General distribution looks okay, but mapped outside geographic range in section 222.	Reclassified any occurrences in section 222 as North-Central Interior Freshwater Marsh.	Restrictions based on ecoregion helped constrain this type to more probable areas of occurrence, but such changes were by necessity simplistic in nature.
Laurentian-Acadian Lakeshore Beach	0	System occurs as small patches on the landscape. Not mapped and difficult to capture given map resolution	None	Not mapped; difficult to capture given map resolution.
Laurentian-Acadian Northern Hardwoods Forest	7,725,228	Mapped distribution looks okay as is.	None	The distribution of this type appears fairly accurate.
Laurentian-Acadian Northern Pine-(Oak) Forest	429,305	Range should be modified to remove mapped occurrences from hemi-boreal environments. This should not occur in Arrowhead of MN and along Lake Superior shoreline (except in parts of WI).	Reclassified as Managed Tree Plantation outside of Sections 212H, 212I, 212J, 212K, 212Nc, 212P, 212Q, 212R, 212S, 212T, 212U, 212V, 212X, 212Y, or 212Z	Restrictions based on ecoregion helped constrain this type to more probable areas of occurrence, but such changes were by necessity simplistic in nature. Some areas reclassified as Managed Tree Plantations may actually be natural forest types within the ecoregions affected.
Laurentian-Acadian Pine-Hemlock-Hardwood Forest	264,483	General distribution look okay as is.	None	The distribution of this type appears fairly accurate.
Laurentian-Acadian Wet Meadow-Shrub Swamp	393,550	General distribution looks good, but this should not be mapped in section 222.	Reclassified as North-Central Interior Wet Meadow-Shrub Swamp if in 222.	Restrictions based on ecoregion helped constrain this type to more probable areas of occurrence, but such changes were by necessity simplistic in nature.
Lower Mississippi River Dune Pond	0	System occurs as small patches on the landscape. Not mapped and difficult to capture given map resolution	None	Not mapped; difficult to capture given map resolution.

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System Name	Area in Final Map (ha)	Notes on Accuracy of Source Data	Actions Taken	Notes on Accuracy of the Final Map
Lower Mississippi River Dune Woodland and Forest	0	This occurs in Missouri, but does not appear to be well capture by Landfire. Most areas mapped as this are unvegetated and should be changed to an unvegetated type (mines/quarries being the best fit). Within the floodplain, occurrences would be better labeled as Mississippi River Riparian Forest.	Reclassified as mines/quarries in Missouri and Illinois if located outside subsections 234Da and 231Hf. In those subsections, this was reclassified to become Mississippi River Riparian Forest.	While this system occurs in limited quantities in Missouri, it is not well represented in the Landfire data. It is thus no longer an included class in the Midwest map.
Lower Mississippi River Flatwoods	6,845	Map does not appear to capture these well.	Reclassified all previously mapped pixels as Ruderal Forest and them used element occurrence data to burn in known occurrences in Missouri.	The map changes offer a large improvement over the original mapped distribution in the Midwest. However, by relying on EO boundaries, small occurrences of this type may be missed.
Managed Tree Plantation	928,303	Not reviewed	Changes in the mapped area of this type are due to occurrences of various natural systems being reclassified as this type.	May be confused with Laurentian Pine-Oak Barrens and Laurentian-Acadian Pine-Hemlock-Hardwood Forest in areas, although changes were made to minimize these issues.
Mississippi River Alluvial Plain Dry-Mesic Loess Slope Forest	0	Within the Midwest, a small patch was errantly mapped as this type on Crowley's ridge.	After verifying this patch does not occur on sandy soils, we reclassified the small area mapped as this type to be Crowley's Ridge Mesic Loess Slope Forest.	No longer mapped in the Midwest.
Mississippi River Bottomland Depression	435	Okay for now. In the future, might want to consider this in conjunction with splitting apart the Mississippi River Floodplain and Riparian Forest aggregate.	None	Distribution looks okay, but this type should be considered in any efforts to split apart the Mississippi River Floodplain and Riparian Forest aggregate.

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System Name	Area in Final Map (ha)	Notes on Accuracy of Source Data	Actions Taken	Notes on Accuracy of the Final Map
Mississippi River Floodplain and Riparian Forest	33,372	This is an aggregate system that includes multiple floodplain types, with limited extent in the Midwest. This is a target for splitting into components in the future, with input from Southeastern states.	None	This is an aggregate system that includes multiple floodplain types, with limited extent in the Midwest. This is a target for splitting into components in the future, with input from Southeastern states.
Mississippi River High Floodplain (Bottomland) Forest	0	This is a component of the Mississippi River Floodplain and Riparian Forest aggregate system and is mapped as such. In the future, might want to consider this in conjunction with splitting apart the Mississippi River Floodplain and Riparian Forest aggregate.	None	This is a component of the Mississippi River Floodplain and Riparian Forest aggregate system and is mapped as such. In the future, might want to consider this in conjunction with splitting apart the Mississippi River Floodplain and Riparian Forest aggregate.
Mississippi River Low Floodplain (Bottomland) Forest	5,420	Okay for now. In the future, might want to consider this in conjunction with splitting apart the Mississippi River Floodplain and Riparian Forest aggregate.	None	Distribution looks okay, but this type should be considered in any efforts to split apart the Mississippi River Floodplain and Riparian Forest aggregate.
Mississippi River Riparian Forest	13,832	Okay for now. In the future, might want to consider this in conjunction with splitting apart the Mississippi River Floodplain and Riparian Forest aggregate.	None	Distribution looks okay, but this type should be considered in any efforts to split apart the Mississippi River Floodplain and Riparian Forest aggregate.
Non-Specific Disturbed	93,505	Not reviewed	None	NA
North-Central and Appalachian Rich Swamp	155,554	Not currently mapped	This type was added by reclassifying mapped occurrences of North-Central Interior Floodplain that occurred at elevations greater than 250m and stream distances > 350m as this type.	The mapping of this system would be improved by use of regionally consistent, high-accuracy floodplain data to segregate this from North-Central Interior Floodplains.

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System Name	Area in Final Map (ha)	Notes on Accuracy of Source Data	Actions Taken	Notes on Accuracy of the Final Map
North-Central Appalachian Acidic Cliff and Talus	0	System occurs as small patches on the landscape. Not mapped and difficult to capture given map resolution	None	Not mapped; difficult to capture given map resolution.
North-Central Appalachian Acidic Swamp	0	Not mapped and difficult to capture given map resolution	None	Not mapped; difficult to capture given map resolution.
North-Central Appalachian Circumneutral Cliff and Talus	0	System occurs as small patches on the landscape. Not mapped and difficult to capture given map resolution	None	Not mapped; difficult to capture given map resolution.
North-Central Interior and Appalachian Acidic Peatland	214,952	Roughly, the distribution looks good, but with overmapping in Minnesota. Many patches look like a combination of this system and adjacent agricultural land.	Evaluated soils (percent histosols) as a means to better restrict the distribution. However, >50% of observed occurrences occur where SSURGO indicates 0% histosols, and thus no action was taken to further restrict the mapped distribution.	This system appears somewhat overmapped, with some mapped pixels likely representing agricultural land adjacent to true patches. Attempts to refine the distribution using soils data (histosols) proved unsuccessful.
North-Central Interior and Appalachian Rich Swamp	155,554	System occurs as small patches on the landscape. Not mapped and difficult to capture given map resolution	None	Not mapped; difficult to capture given map resolution.
North-Central Interior Beech-Maple Forest	1,657,408	The transition boundary between this and South Central Mesophytic Forest is still somewhat undefined in northeast Ohio, but it is reasonable to retain this type as mapped in sections 222L, 222R, 212X, 212K, 212Q, and 212Y. The mapped distribution in the source data erroneously includes Illinois, western Wisconsin, and Iowa.	Reclassified this to North-Central Interior Maple Basswood forest in all sections outside 222L, 222R, 212X, 212K, 212Q, and 212Y.	Restrictions based on ecoregion helped constrain this type to more probable areas of occurrence, but such changes were by necessity simplistic in nature. The transition boundary between this and South Central Mesophytic Forest is still somewhat undefined in northeast Ohio.

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System Name	Area in Final Map (ha)	Notes on Accuracy of Source Data	Actions Taken	Notes on Accuracy of the Final Map
North-Central Interior Dry Oak Forest and Woodland	1,264,404	Distribution looks okay, although may be missing patches occurring in central Indiana.	None	In general, the distribution looks okay, although this may be underrepresented in central Indiana.
North-Central Interior Dry-Mesic Oak Forest and Woodland	3,693,899	May be undermapped in Section 223G in Indiana and parts of Michigan. In Northeastern Ohio, this is mapped outside its range.	Reclassified as Northeastern Interior Dry-Mesic Oak Forest in section 221F.	Restrictions based on ecoregion helped constrain this type to more probable areas of occurrence, but such changes were by necessity simplistic in nature. This type appears to be undermapped in Section 223G in Indiana and parts of Michigan but we could not identify a feasible way to improve the mapping in these areas.
North-Central Interior Floodplain	1,432,976	Mapped outside its geographic range as well as outside floodplains.	Reclassified anything outside of ecoregions 222, 251, and 221F as Central Appalachian River Floodplain. Performed CART modeling to identify places where this is mapped outside of floodplains. Based on the model results, we reclassified anything with an elevation > 250 meters AND a stream distance > 350 meters as North-Central and Appalachian Rich Swamp.	Restrictions based on ecoregion helped constrain this type to more probable areas of occurrence, but such changes were by necessity simplistic in nature. CART modeling helped to better limit the distribution to true floodplains, although results would be improved by if regionally consistent, high-accuracy data for floodplains could be obtained.
North-Central Interior Freshwater Marsh	252,919	General distribution looked okay, but some erroneously mapped in ecoregion 212.	Reclassified anything in 212 to Laurentian-Acadian Freshwater Marsh.	The general distribution looks good. Restrictions based on ecoregion helped constrain this type to more probable areas of occurrence, but such changes were by necessity simplistic in nature.

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System Name	Area in Final Map (ha)	Notes on Accuracy of Source Data	Actions Taken	Notes on Accuracy of the Final Map
North-Central Interior Maple-Basswood Forest	2,021,935	Mapped outside its geographic range.	Reclassified anything in ecoregion 223Ak to Ozark-Ouachita Mesic Hardwood forest and anything in EPA ecoregions 56b, 56g, 56h, 57e, 57a, and 57b to North-Central Interior Beech-Maple Forest.	Restrictions based on ecoregion helped constrain this type to more probable areas of occurrence, but such changes were by necessity simplistic in nature.
North-Central Interior Oak Savanna	3,360	This system appears drastically overmapped in the Landfire data.	Reclassified all occurrences as North-Central Interior Dry Oak Forest and Woodland and then burned known occurrences into the map using Element Occurrence records.	The map changes offer a large improvement over the original mapped distribution in the Midwest. However, by relying on EO boundaries, small occurrences of this type may be missed.
North-Central Interior Quartzite Glade	0	System occurs as small patches on the landscape. Not mapped and difficult to capture given map resolution	None	Not mapped; difficult to capture given map resolution.
North-Central Interior Sand and Gravel Tallgrass Prairie	31,474	Overmapped within its range.	Reclassified all pixels not occurring on sandy soils (SSURGO > 70% sand) as Ruderal-Old Field and used Element Occurrence records to burn in additional known patches.	Restriction by soil type and the use of element occurrence substantially improved the mapping of this type.
North-Central Interior Shrub-Graminoid Alkaline Fen	0	Included in an aggregate mapping unit by Landfire so not mapped separately. Difficult to capture given map resolution compared to the generally small occurrences of this System.	None	Not mapped; difficult to capture given map resolution.
North-Central Interior Wet Flatwoods	100,456	Mapped distribution looks okay as is.	None	The distribution of this type appears fairly accurate.

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System Name	Area in Final Map (ha)	Notes on Accuracy of Source Data	Actions Taken	Notes on Accuracy of the Final Map
North-Central Interior Wet Meadow-Shrub Swamp	541,226	General distribution looks good, but mapped outside geographic range in ecoregion 212.	Reclassified anything in 212 as Laurentian-Acadian Wet Meadow-Shrub Swamp.	Restrictions based on ecoregion helped constrain this type to more probable areas of occurrence, but such changes were by necessity simplistic in nature.
North-Central Oak Barrens	4,880	Overmapped, both within and outside its geographic range.	Within its known range, reclassified all pixels mapped as the to North-Central Interior Dry Oak Forest and Woodland. Outside its range (i.e. in section 212, excluding subsections 212Ha and 212Hb) reclassified all pixels as Laurentian Pine-Oak Barrens. Then used EOs to burn in known locations for this rare type.	The map changes offer a large improvement over the original mapped distribution in the Midwest. However, by relying on EO boundaries, small occurrences of this type may be missed.
Northeastern Interior Dry-Mesic Oak Forest	390,217	Confused with SCI Mesophytic Forest (4127) and Hemlock-Hardwood System (4308).	We attempted to model this system using the Topographic Convergence index, but were unable to do so successfully. Additional modeling may be attempted by NatureServe in the future to revise this system.	Despite attempts at modeling, we were unable to successfully segregate this system from South-Central Interior Mesophytic Forest and Hemlock-Hardwood systems. This should be a priority for future map improvement projects.
Northern Atlantic Coastal Plain Hardwood Forest	0	Erroneously mapped in southern Indiana and southwest Ohio, mostly in suburban/exurban areas.	Reclassified all pixels as Interior Low Plateau Dry-Mesic Oak Forest.	No longer mapped in the Midwest.
Northern Atlantic Coastal Plain Pond	0	System occurs as small patches on the landscape. Not mapped and difficult to capture given map resolution	None	Not mapped; difficult to capture given map resolution.
Northern Crowley's Ridge Sand Forest	17,502	No changes recommended.	None	General distribution appears accurate.

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System Name	Area in Final Map (ha)	Notes on Accuracy of Source Data	Actions Taken	Notes on Accuracy of the Final Map
Northern Great Lakes Coastal Marsh	876	Distribution looks okay, although in places this is erroneously mapped at distance from the Great Lakes.	Buffered Great Lakes shorelines by 0.5 miles and reclassified any pixels outside this buffer as Laurentian-Acadian Freshwater Marsh.	Restrictions based on distance to shoreline helped constrain this type to more probable areas of occurrence, but such changes were by necessity simplistic in nature.
Northern Great Lakes Interdunal Wetland	0	System occurs as small patches on the landscape. Not mapped and difficult to capture given map resolution	None	Not mapped; difficult to capture given map resolution.
Northern Tallgrass Prairie	43,247	Way too much is mapped, and many patches have straight borders, indicating confusion with agriculture.	Reclassified all mapped pixels as Agriculture - Pasture/Hay and then burned in known occurrences using Element Occurrence records, and for ecoregions 251Ba, Bb, Aa, and 22Na, the Minnesota prairies map. The Minnesota prairie data was filtered to only include polygons greater than 0.25 acres and not labeled CRP.	The map changes offer a large improvement over the original mapped distribution in the Midwest. However, by relying on EO boundaries, small occurrences of this type may be missed.
Northwestern Great Plains Mixedgrass Prairie	0	Mapped outside geographic range.	Reclassified as Central Tallgrass Prairie.	No longer mapped in the Midwest.
Northwestern Great Plains Riparian	0	This is erroneously mapped in western Minnesota, and appears to be another wetland system.	Reclassified all pixels as Eastern Great Plains Wet Meadow, Prairie, and Marsh.	No longer mapped in the Midwest.
Open Water	17,863,006	Not reviewed	None	NA
Ozark Prairie and Woodland	0	System occurs as small patches on the landscape. Not mapped and difficult to capture given map resolution	None	Not mapped; difficult to capture given map resolution.

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System Name	Area in Final Map (ha)	Notes on Accuracy of Source Data	Actions Taken	Notes on Accuracy of the Final Map
Ozark-Ouachita Dry Oak Woodland	52,947	Appears to be somewhat undermapped; stands that should be this appear mapped as Ozark-Ouachita Dry-Mesic Oak Forest and Woodland.	None (no efficient means of systematically fixing the observed errors was identified)	This remains somewhat undermapped; stands that should be this are mapped as Ozark-Ouachita Dry-Mesic Oak Forest and Woodland but no efficient means of fixing these errors was identified.
Ozark-Ouachita Dry-Mesic Oak Forest	4,330,665	Mapped outside its geographic range in ecoregion 223Gb and possibly overmapped elsewhere.	Reclassified occurrences in 223Gb as North-Central Interior Dry-Mesic Oak Forest and Woodland.	Restrictions based on ecoregion helped constrain this type to more probable areas of occurrence, but such changes were by necessity simplistic in nature.
Ozark-Ouachita Fen	151	Not mapped and difficult to capture given map resolution	Burnt into the map using element occurrence records.	The map changes offer a large improvement over the original mapped distribution in the Midwest. However, by relying on EO boundaries, small occurrences of this type may be missed.
Ozark-Ouachita Mesic Hardwood Forest	353,571	Possibly undermapped, but review of distribution did not identify obvious errors warranting revisions.	None	Possibly undermapped, but review of distribution did not identify obvious errors warranting revisions.
Ozark-Ouachita Riparian	23,835	Mapped distribution looks okay as is.	None	General distribution appears accurate.
Ozark-Ouachita Shortleaf Pine-Bluestem Woodland	0	Not currently mapped in the Midwest.	Considered burning in using element occurrence records, but did not end up doing so because of a lack of current EO data for this type.	Not mapped; difficult to capture given map resolution and insufficient element occurrence data.
Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland	267,229	Mapped distribution looks okay as is.	None	General distribution appears accurate.
Paleozoic Plateau Bluff and Talus	255,471	Mapped distribution looks okay as is.	None	General distribution appears accurate.

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System Name	Area in Final Map (ha)	Notes on Accuracy of Source Data	Actions Taken	Notes on Accuracy of the Final Map
Quarries/Strip Mines/Gravel Pits	9,228	No review.	None. Changes in area are due to some natural systems being reclassified as this type.	NA
Recently Logged Timberland-Herbaceous Cover	2	No review.	None	NA
Ruderal Forest	316,395	No review.	None. Changes in area are due to some natural systems being reclassified as this type.	Ruderal forest is somewhat of a catch all; some areas classified as this may actually be wetlands, plantations, or other types but the available data did not support additional differentiation.
Ruderal Upland - Old Field	606,794	No review.	None. Changes in area are due to some natural systems being reclassified as this type.	Ruderal types are particularly hard to map due to their often changing nature.
South-Central Interior / Upper Coastal Plain Flatwoods	0	System occurs as small patches on the landscape. Not mapped and difficult to capture given map resolution	None	Not mapped; difficult to capture given map resolution.
South-Central Interior / Upper Coastal Plain Wet Flatwoods	504	Small amount is erroneously mapped in Missouri.	Reclassified all pixels in Missouri as Mississippi River Riparian forest.	General distribution appears accurate.
South-Central Interior Large Floodplain	184,828	Possibly undermapped, but the general distribution appears correct.	None	General distribution appears fairly accurate, although this type may be somewhat undermapped.

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System Name	Area in Final Map (ha)	Notes on Accuracy of Source Data	Actions Taken	Notes on Accuracy of the Final Map
South-Central Interior Mesophytic Forest	2,345,521	General distribution looks okay, but appears missing from the northern boundary of Omernik ecoregion 55b to the northern boundary of Map Zone 47 (only Southern Interior Low Plateau Dry-Mesic Oak Forest is mapped in this band). Retroactively fixing this would be difficult, however.	None	General distribution appears fairly accurate, although this type may be somewhat undermapped, although it appears missing from the northern boundary of Omernik ecoregion 55b to the northern boundary of Map Zone 47 (only Southern Interior Low Plateau Dry-Mesic Oak Forest is mapped in this band). An efficient means to retroactively add this to the map in those areas was not identified.
South-Central Interior Small Stream and Riparian	17,149	General distribution looks okay, but somewhat overmapped and mapped in too close proximity to the Ohio River in some locations.	None	General distribution appears fairly accurate, although possibly overmapped in some areas, particularly in proximity to the Ohio River.
Southeastern Great Plains Tallgrass Prairie	12,189	Overmapped. All examples reviewed were actually agriculture. Our fix may overcorrect (i.e. leave this somewhat undermapped) but will be an improvement.	Reclassified all pixels as Agriculture - Pasture/Hay and burnt in known occurrences using element occurrence records.	The map changes offer a large improvement over the original mapped distribution in the Midwest. However, by relying on EO boundaries, small occurrences of this type may be missed.
Southern Appalachian Low-Elevation Pine Forest	0	Not mapped and difficult to capture given map resolution	None	Not mapped; difficult to capture given map resolution.
Southern Appalachian Montane Pine Forest and Woodland	0	System occurs as small patches on the landscape. Not mapped and difficult to capture given map resolution	None	Not mapped; difficult to capture given map resolution.
Southern Appalachian Oak Forest	0	Should not be mapped in the Midwest.	Reclassified all pixels as Allegheny-Cumberland Dry Oak Forest and Woodland.	No longer mapped in the Midwest.
Southern Crowley's Ridge Mesic Loess Slope Forest	11,291	General distribution looks okay as is.	None	General distribution appears accurate.

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System Name	Area in Final Map (ha)	Notes on Accuracy of Source Data	Actions Taken	Notes on Accuracy of the Final Map
Southern Interior Low Plateau Dry-Mesic Oak Forest	784,004	General distribution looks okay, with the exception of ecoregion 222 where this is mapped outside its geographic range.	Reclassified all pixels in ecoregion 222 as North-Central Interior Dry-Mesic Forest and Woodland.	Restrictions based on ecoregion helped constrain this type to more probable areas of occurrence, but such changes were by necessity simplistic in nature.
Southern Ridge and Valley / Cumberland Dry Calcareous Forest	0	Should not be mapped in the Midwest.	Reclassified all pixels as South-Central Interior Mesophytic Forest.	No longer mapped in the Midwest.
Successional Shrub/Scrub	43,142	No review.	None	NA
Successional Shrub/Scrub (Clear Cut)	16,555	No review.	None	NA
West Gulf Coastal Plain Mesic Hardwood Forest	0	Should not be mapped in the Midwest.	Reclassified all pixels as Ozark-Ouachita Mesic Hardwood Forest.	No longer mapped in the Midwest.
West Gulf Coastal Plain Small Stream and River Forest	0	Should not be mapped in the Midwest.	Reclassified all pixels as Northern Crowley's Ridge Sand Forest.	No longer mapped in the Midwest.
West Gulf Coastal Plain Southern Calcareous Prairie	0	Should not be mapped in the Midwest.	Reclassified all pixels as Ruderal Upland-Old Field.	No longer mapped in the Midwest.
Western Great Plains Depressional Wetland Systems	0	Should not be mapped in the Midwest.	Reclassified all pixels as Eastern Great Plains Wet Meadow, Marsh, and Wet Prairie.	No longer mapped in the Midwest.
Western Great Plains Dry Bur Oak Forest and Woodland	0	Should not be mapped in the Midwest.	Reclassified all pixels as North-Central Interior Dry-Mesic Oak Forest and Woodland.	No longer mapped in the Midwest.
Western Great Plains Shortgrass Prairie	0	Should not be mapped in the Midwest.	Reclassified all pixels as Agriculture - Pasture/Hay.	No longer mapped in the Midwest.
Western Great Plains Wooded Draw and Ravine	23,737	General distribution looks okay as is.	None	General distribution appears accurate.