Final Draft

Standardized National Vegetation Classification System

USGS/NPS Vegetation Mapping Program

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Executive Summary

The objective of the U.S. Geological Survey/National Park Service (USGS/NPS) Vegetation Mapping Program is to develop a uniform hierarchical vegetation classification standard and methodology on a Service-wide basis and, using that classification standard and methodology, to generate vegetation maps for most of the park units under NPS management. This Program is in response to the National Park Service's Natural Resources Inventory and Monitoring Guideline (NPS-75) issued in 1992. The vegetation data are to be automated, in a GIS-compatible format, which will provide great flexibility in map design and production, data analysis, data management, and maintenance activities. Deliverable products will include a digital file of vegetation maps, digital metadata files, textual descriptions and keys to the vegetation classes, hard-copy maps, and map accuracy verification reports.

The use of a standard national vegetation classification scheme and mapping protocols will facilitate effective resource stewardship by ensuring compatibility and widespread use of the information throughout the NPS as well as by other federal and state agencies. These vegetation maps and associated information will support a wide variety of resource assessment, park management, and planning concerns. They will provide a structure for framing and answering critical scientific questions about vegetation types and their relationship to environmental processes across the landscape. They will provide a consistent means for the inventory and monitoring of plant communities and, they will support "ecosystem management" by providing a consistent basis for the characterization of the biological components of different ecosystem units.

The first step toward the implementation of the mapping program includes the development and documentation of standards and protocols. This is being initiated in three studies: (1) a proposed National Vegetation Classification Standard, (2) Field Methodologies, and (3) Accuracy Assessment Procedures. This document is the result of the first study. It has two fundamental purposes. First, it is to describe the structure, content, and origins of the Standard National Vegetation Classification System proposed for adoption by the USGS/NPS Vegetation Mapping Program. Second, it is to describe the process by which the system is to be applied to changing requirements.

The basis or starting point for the NPS Standard National Vegetation Classification System is the vegetation data and classification system developed by The Nature Conservancy (TNC) and the network of Natural Heritage Programs (NHP). This system is the result of synthesizing a great body of earlier scientific effort, as well as twenty years of field data collection and scientific analyses by TNC and NHP scientists. This work has been supported by many federal agency

programs that use the system to meet their resource planning and management objectives. To date, the major public partners in the development and application of this system include the United States Fish and Wildlife Service, the United States Forest Service, the National Park Service, the Environmental Protection Agency, and numerous state agencies. The Ecological Society of America and other academic partners have also contributed to the system. This system is international in scope and is presently being applied across the United States and Canada.

The system is organized hierarchically to support conservation and resource stewardship applications across multiple scales. The upper levels of the hierarchy are based on the physical form or structure of the vegetation (physiognomy) and have been refined from the international standards developed by the United Nations Educational, Scientific, and Cultural Organization (UNESCO). The two most detailed levels of the hierarchy are based on the species composition of existing vegetation (floristics) and reflect the phyto-sociological standards that were originally developed by European ecologists. At this time, more than 2,700 communities across the conterminous United States have been recognized at the finest level (community element) of the hierarchy. The vegetation classification is continually advanced through the collection and analysis of new field data and will be greatly strengthened during the course of the USGS/NPS mapping efforts.

To date, the majority of the vegetation classes have been implemented by a number of contributors using a variety of qualitative and quantitative means, depending on the amount and type of information available. Since the process has not been consistent, confidence levels have been assigned to each community type to identify the quantity and the quality of information available. The results have been, and continue to be, rigorously reviewed as new data become available. Consequently, this work is representative of some of the best field ecology and constitutes an important body of vegetation descriptions and characterizations.

Nevertheless, it is anticipated that the system will need to be expanded and/or modified if it is to meet the challenge of ecosystem management across the diversity of National Park System environments and circumstances. This further development of the classification system will be accomplished with standard methods and procedures.

Currently, standard methodologies for data collection and analysis have been developed, and will be used to incorporate new data and to define and validate new vegetation classes. The Standard National Vegetation Classification System will also be compatible with the standards being developed by the Vegetation Subcommittee of the Federal Geographic Data Committee (FGDC 1993).

These standards will preserve the overall integrity of the classification system as it is further developed, and will enable the full use of the powerful tools of a geographic information system (GIS).

The candidate classification system was selected with the knowledge that it would need to be related to other major classification approaches. It is important that the vegetation data currently available in the parks be exploited for its maximum utility. Cross-references to other major classification systems currently being developed include *Potential Natural Vegetation of the Conterminous United States* (Kuchler,1964), *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979), and *A Digitized Systematic Classification for Ecosystems* (Brown, Lowe, and Pase 1980). Other cross-referencing efforts will be undertaken as necessary and can potentially be integrated into the GIS applications and database.

Another important consideration for the candidate classification system was that it be applicable for mapping using manual photointerpretation techniques. It is planned that the vegetation of each park be mapped through the interpretation of color infrared aerial photography and field verification. Each vegetation polygon is to be classified to the finest floristic level (community element), although field and imagery conditions may require a coarser level of classification for certain vegetation types. The system has been previously used to produce vegetation maps as a component of conservation planning. Though the general objectives have been consistent, the applications have varied in terms of scale, resources, desired end product, and types of remote sensing. Specific mapping projects in Jamaica and Georgia are discussed in this report.

1.0 Introduction

The National Park Service/U.S. Geological Survey (USGS/NPS) Vegetation Mapping Program is ambitious in scope and unique in vision. It is in response to the NPS Inventory and Monitoring Guideline (NPS-75) and the NPS Natural Resources Management Guideline (NPS-77). For the first time in the history of land management in the United States, this project provides a means to map vast acreage – most National Park System units – using a single vegetation classification and mapping standard. The U.S. Geological Survey is a partner with the National Park Service in this project and is largely responsible for technical oversight of protocols and methodology development as well as technical review and approval of the vegetation maps produced.

1.1 Objectives of the Report

The NPS Vegetation Mapping Project specifies the use of a consistent classification system and mapping protocol for vegetation types across all National Park Service lands. The purpose of this report is to review the scientific basis for vegetation classification and mapping, and to propose a standardized National Vegetation Classification System that will serve the objectives of this project.

The classification system has primarily been developed and implemented by The Nature Conservancy and the network of Natural Heritage programs over the past twenty years. The classification system is based on and well integrated with the major scientific efforts in the classification of vegetation. For example, the upper levels of the classification hierarchy are a modification of the systems proposed by UNESCO (1973) and Driscoll et al. (1984). The Nature Conservancy and the Natural Heritage Programs have further refined these systems by relating the repeating vegetation associations that occur on the landscape to these earlier systems.

The protection and management of biodiversity is a charge of both the National Park Service and The Nature Conservancy, and it follows that the classification system developed for use by The Nature Conservancy would also have utility and application to the national parks. It incorporates data from a wide variety of sources and is international in scope. Many years of experience and review have been invested in the development of this system, which is broadly accepted and consistently applied across the United States by The Nature Conservancy, the Natural Heritage network, and multiple federal agency partners. It undergoes continuous review and expansion, is scientifically sound, yet flexible, cost-effective, and efficient.

This report will be reviewed by scientists, resource managers, and park management staff to evaluate whether this National Vegetation Classification System can be applied to meet their program objectives. The review is expected to stimulate dialogue among all involved researchers, provoke constructive feedback and comments, and ultimately help to refine the classification system to better meet the objectives of USGS/NPS.

1.1.1 Relationship to Other Reports in This Series

This is the first of a set of three reports that are being completed to describe the proposed methods for the USGS/NPS Vegetation Mapping Project. This report proposes the vegetation system to use for the classification and mapping standard. The second report describes the field methods that will be employed to implement an accurate vegetation mapping process across all national parks. The third report describes the accuracy assessment methods that will be utilized to measure the quality of the vegetation maps.

1.2 Structure of the Report

This report proposes a standardized national vegetation classification system that will meet the objectives of the USGS/NPS Vegetation Mapping Project.

Section 1 reviews the USGS/NPS Vegetation Mapping Project objectives and requirements for the development and application of a standardized national vegetation classification system.

Section 2 stresses the importance of a national vegetation classification standard that will meet the multiple objectives of the National Park Service and the U.S. Geological Survey and identifies the specifications that are required of this standard.

Section 3 provides a historical review of vegetation classification, and provides the theoretical background for the national vegetation classification system.

Section 4 summarizes the principles and processes employed by The Nature Conservancy in developing a national vegetation classification system.

Section 5 describes the standards, structure, process and present status of the national vegetation classification system.

Section 6 describes the relationship of the national vegetation classification system to vegetation maps and mapping.

Section 7 reviews the objectives of the USGS/NPS Vegetation Mapping Project and the process of fitting the national vegetation classification system to these objectives.

Section 8 summarizes the proposed system in light of the requirements for a national standard.

Section 9 lists the authors and contributors to the report.

Section 10 lists the literature that was cited in the report.

Section 11 contains all appendixes referenced in the report

1.3 Terms of the Vegetation Mapping Project

1.3.1 Project Objectives

The primary objective of the USGS/NPS vegetation mapping project is to produce high-quality, standardized maps of the vegetation and other land cover occurring within the national parks and environs. These maps and associated information are required to support a wide variety of resource assessment, management, and conservation concerns. These resource assessments are needed at the individual park as well as the regional and national levels. The use of a standard national vegetation classification scheme and mapping protocols will facilitate effective resource management by ensuring compatibility and widespread use of the information at multiple geographic scales throughout the NPS as well as by other federal and state agencies.

1.3.2 Contract Requirements

1.3.2.1 Classification System

The standard classification system must be applied across all national parks. The national vegetation classification system must be compatible with the standards being developed by the Vegetation Subcommittee of the Federal Geographic Data Committee (FGDC)(1993).

1.3.2.2 Map Scale

Vegetation maps will be produced at the scale of 1:24,000. The general rule for the size of the minimum mapping unit is 0.5 hectares.

1.3.2.3 Map Accuracy

The vegetation maps must meet the National Map Accuracy Standards for positional accuracy, and the minimum class accuracy goal across all vegetation and land cover classes is 80 percent.

1.3.2.4 Digital Products

The maps will be provided in both hard-copy and digital format. The field data will be provided in an SQL-based digital database management system (DBMS). Deliverable products may also include a digital file of vegetation maps; a digital metadata file for each data file delivered; textual descriptions and keys to the vegetation classes; and map accuracy verification.

2.0 The Importance of a National Vegetation Classification Standard

It has been noted repeatedly over the past few decades that the implementation of a standard national vegetation classification system will enhance our ability to understand, protect, and manage the natural resources of the United States. Until recently, a national mandate has been lacking to make this a reality and the incentives have not been sufficiently powerful to resolve local differences into an accepted national standard. A primary goal of the NPS vegetation mapping project is to refine and implement this national vegetation classification standard. Of this effort, Interior Secretary Bruce Babbitt recently stated, "This [project] will strengthen our understanding of the dynamics of plant communities in parks. NPS then can improve management and preservation practices to perpetuate the precious resources entrusted to its care."

2.1 Applications of a Standard National Vegetation Classification System

2.1.1 Facilitate Regional and National Resource Assessments

Past efforts to map vegetation across the national parks did not utilize national standards for vegetation classification, data quality, and accuracy assessment because they did not exist. Along with other land management agencies, the national parks used local classifications when available, or had to develop their own. These vegetation maps have been valuable for evaluating the resources within a specific park, but have been generally incompatible from park to park. The major reason for this incompatibility is that local classifications often use different names for vegetation types with similar characteristics. Because past vegetation mapping projects lacked common language and evaluation standards, the products from these efforts have had limited utility for regional resource assessment and analyses.

The national vegetation classification system will provide a common language for describing vegetation and will facilitate assessments of vegetation from multiple scales and perspectives. Such a system will enable information to be compiled on the range, status, and variability of specific vegetation types. Similarly, it will allow the identification of the critical knowledge gaps so that efforts to acquire additional data can be prioritized and coordinated.

2.1.2 Advance Scientific Knowledge

The identification and description of standard vegetation types across the landscape provides the structure for framing and answering critical scientific questions about these vegetation types. These questions include determining (1) the origin and geographic distribution of vegetation types, (2) their relation to one another across the landscape, (3) the relative importance of individual vegetation types, (4) description of vegetation types including their overall species composition and variability, and (5) the relationship of these types to environmental and ecological processes across the landscape. Answers to these questions build the basis for refining the classification system and lead to better understanding, protection, and management of natural resources.

2.1.3 Support Park Planning and Natural Resource Management

A practical application of a standard classification system is natural resource planning and management. A standard taxonomy for vegetated communities allows for the identification of basic, comparable units at local, regional, and national scales. Inventory and monitoring of comparable vegetation types can help identify objectives for park planning and resource management. Information on the spatial, temporal, and ecological properties of the vegetation types can be gathered, ultimately leading to the development of the best possible plans to understand, protect, and manage these resources.

2.1.4 Support Ecosystem Management Initiatives

Over the past few years, most federal agencies have been redefining their missions to conform to an "ecosystem approach to management." The meaning of "ecosystem management" and what this approach will accomplish are now being articulated by each agency. The intent of this ecosystem management focus is to encourage the development and implementation of new resource management approaches that are solidly based upon the inherent ecological capacity of the landscape. It is hoped that this new approach to resource management will promote more sustainable land use practices with reduced impact on the environment.

An ecosystem is broadly defined as a unit of the landscape that is somehow "tied together" through a shared set of ecological processes. These ecosystems may be delineated using different ecological variables at multiple scales. At this point, different agencies are delineating ecosystem units that will help them address their agency-specific objectives.

Variation in the definition of ecosystems between the agencies makes it important to apply common descriptions to these units across the physical and administrative landscape. The standard vegetation classification system provides the consistent basis for the characterization of the biological components of different ecosystem units. This will enable comparison of the ecosystem units of the NPS to those of the (USFS) and (USFWS) in the same region by their vegetation types and associated environmental attributes. The common currency of vegetation types within the ecosystem units will be a major asset in the support of interagency coordination and cooperation in the areas of inventory and monitoring, resource management, and biodiversity conservation.

The classification and description of ecosystem units are critical first steps in building the framework for ecosystem management planning. A consistent classification of ecological communities will allow the mapping of vegetation patterns across the landscape and evaluation of vegetation relationships to ecological processes. Identification of the patterns of biological diversity within a landscape and ecosystem context provides the context for the development of sustainable management plans for these ecosystems.

2.2 Specifications/Requirements of a Candidate Standard

The development of standard methods for vegetation inventory, classification and mapping will support the advancement of biological science, biodiversity conservation, and applied resource management. While objectives may differ, these disciplines share the need to consistently identify and describe the ecological community types. No one standard classification approach can address all objectives equally well. The benefits of implementing one pragmatic classification system are compelling.

The specifications for a national vegetation classification standard are listed below:

- The classification system must be scientifically defensible and present a logical progression from existing methods.

- The classification process must be repeatable.

- The classification must employ standard terminology and quantifiable field sampling and data analysis methods so levels of confidence can be documented.

- The classification methods should be broadly accepted both nationally and internationally.

- The system must consistently classify existing biological associations that repeat across the landscape.
- The classification units must be ecologically meaningful.
- The classification units must be mappable from polygons that are discernable on imagery.
- The classification system must be hierarchically organized such that it can be applied at different spatial scales.
- This system must identify units at an appropriate scale to meet the objectives for resource management and biodiversity conservation.
- The system must be flexible and open ended such that it will allow for additions, modifications, and continuous refinement.
- The classification must be accessible to users to adopt and refine with necessary quality control measures in place.
- The system must be well documented.

3.0 Vegetation Classification: Background

3.1 What is Classification?

The objective of classification is to group together a set of observational units on the basis of their common attributes (Kent and Coker 1992). The end product of a classification should be a set of groups derived from the units of observation where, typically, units within a group share more attributes with one another than with units in other groups. For vegetation classification, the unit of observation is typically the "stand," defined as a relatively homogeneous area with respect to species composition, structure, and function.

The process of classifying a particular type of vegetation on the landscape requires a clearly defined objective for the classification and a familiarity with the variability across its range. If the objective of a study is to create an independent vegetation classification system, attribute data on species, cover, vegetation age and structure, leaf characteristics, bark characters, dispersal mechanisms and life history traits should be collected and organized. If the objective is to classify ecosystems, data on the key environmental features such as soils, hydrology, landform, etc., need to be collected. The biological and environmental information to be collected, organized, and described must be carefully chosen to meet the objectives of the classification.

3.1.1 Community Units and Continua

Within the Anglo-American ecological tradition, there has been a disinterest in classification *per se*. Beginning with the viewpoint of Gleason (1917, 1926), extended by others, including Whittaker (1956, 1962) and Curtis (1959), it is held that vegetation units cannot be defined; species comprising a community respond individually to environmental gradients and to each other. Whittaker (1962) referred to this viewpoint as the "individualistic dissent." The question often became polarized between the "continuum concept" and the "community unit concept." The argument is still presented in such a polarized light today, despite efforts to broaden the discussion (Moravec 1992, Roughgarden 1989).

Despite the polarized viewpoints, several features of communities are widely recognized (Mueller-Dombois and Ellenberg, 1974):

- Similar species combinations recur.

- No two stands (or sampling units) are exactly alike.
- Species assemblages change more or less continuously if one samples a geographically widespread community throughout its range.

Thus, recurring species combinations are variously correlated with their environment, and these shift geographically. Austin (1991) considered that vegetation units will be most interpretable within certain landscape regions. In sum, an ordering is possible, but within limits. Vegetation classifications often require a predetermined consistency that does not do justice to the complexity and variability of the units. The same may be said for land classifications. The goal of classification is to determine the relative degree of similarity and dissimilarity among units while recognizing that the communities are distributed on a continuum across the landscape.

3.2 Review of Different Approaches to Classification

Many vegetation classification systems have been developed, but three have gained widespread acceptance: physiognomic classifications, floristic classifications, and site or ecosystem classifications (Howard and Mitchell, 1985). The intent of all three is to provide a systematic ordering of vegetation or ecosystem pattern and to relate these patterns to ecological processes. Following is a brief survey of various classification systems and a description of their strengths and limitations.

3.2.1 Vegetation Classifications

3.2.1.1 Physiognomic Methods

Beginning in the nineteenth century, with the work of plant geographers such as Humboldt, Warming, and Grisebach, vegetation classification focused on the outward appearance or physiognomy of the vegetation. Broadly speaking, physiognomy refers to structure (height and spacing of the vegetation) and life forms of the dominant species (the gross morphology and growth aspect of the plants). In addition, physiognomy refers to characters of seasonality, leaf shape, phenology, duration, etc. These features are easily recognized in the field and can be applied with little knowledge of the flora. In addition, they permit generalizations about the vegetation at a coarse, often worldwide scale.

The basic unit of several physiognomic classification systems is the "formation." a "community type defined by dominance of a given growth form in the uppermost stratum (or the uppermost closed stratum) of the community, or by a combination of dominant growth forms" (Whittaker 1962). In practice, formations are defined by varied, conventionally accepted combinations of growth-form dominance and characteristics of the environment. "Cold-deciduous alluvial forests," "evergreen subdesert shrublands," and "alpine meadows" are examples of formations. The predominance of certain physiognomic types in a region tend to correspond to major climatic zones. Thus, physiognomic categories are often expressions of macroclimate, soils, and vegetation (Holdridge 1947, Walter 1985, Howard and Mitchell 1985). As a result, broad-leaved evergreen trees tend to be found in tropical climates, evergreen needle-leaved trees tend to be found in boreal climates, etc. Physiognomic features provide a fast, efficient way to categorize vegetation, can often be linked to remote sensing signatures, and are useful for initial reconnaissance of areas requiring survey. Physiognomic classification systems generally emphasize a divisive (or "top-down") approach, subdividing coarse vegetation patterns into units suitable for small-scale assessment. In addition, physiognomy reflects the effects of disturbance and management (such as grazing or fire), though in a relatively coarse way.

In the twentieth century, the physiognomic traditions of Warming and others were expanded in several directions (as described in detail by Whittaker 1962 and Shimwell 1971). In Europe, Brockman-Jerosch and Rubel (1912) and Rubel (1930) emphasized physiognomy together with species dominance. Their methods were expanded by Fosberg (1961), Ellenberg and Mueller-Dombois (1967) and the United Nations Educational, Scientific and Cultural Organization (UNESCO 1973). In the United States, Clements (1916, 1928), and later Braun (1947, 1950) identified broad-scale regional formations, described by major dominants sharing the same physiognomy. More appropriately called "vegetational regions," these units described what were thought to be the "climatic climax types," areas of vegetation that were typical, mature phases of the vegetation. Other recent descriptions of vegetation in the United States that emphasize physiognomic units can be found in Vankat (1979), Barbour and Billings (1988), and Barbour and Christensen (1993). In Great Britain, the work of Moss (1913), Clements (1916), Watt (1934), and Tansley (1939) described both climatic climaxes and edaphic climaxes, areas of vegetation occurring on different soils within the same climate (poly-climax types). In the tropics, structural profiles of the vegetation were described in detail and physiognomic units characterized the layers (Richards 1952, Beard 1955, Cain *et al*. 1956).

Mapping standards improved as cartographic techniques summarizing vegetation structure through symbols were developed by Dansereau (1951) and Kuchler (1949, 1967). Kuchler's (1964) work led to a physiognomic vegetation map of the United States that has received widespread use and management application (Klopatek *et al*. 1979, Crumpacker *et al*. 1988).

3.2.1.2 Floristic Methods

Whereas most physiognomic methods emphasize attribute patterns of dominant species groups in the vegetation, floristic methods characterize the species themselves. The basic floristic unit is the "association," defined by Flahault and Schroter (1910) as "a plant community of definite floristic composition, presenting a uniform physiognomy, and growing in uniform habitat conditions." This definition implies that associations that share a certain physiognomy would be grouped together into the same formations.

In defining associations, some floristic methods focus on species that occur constantly throughout a set of stands, while others emphasize indicator or diagnostic species, species that are dominant or restricted to these stands. Floristic methods require intensive field sampling, detailed knowledge of the flora, and careful tabular analysis of stand data to determine the constant or diagnostic species groups. Floristic methods reflect local and regional patterns of vegetation and are more detailed than physiognomic methods. They also provide detailed descriptions of biotic communities regardless of their successional stage or origin. As such, they are typically organized by an agglomerative (or "bottom-up") approach, with lower units being combined into higher ones. Floristic composition is often correlated with soil or landform patterns. Thus, floristic units have been used frequently as indicators of ecosystem processes and are a useful component of ecosystem classifications (Mueller-Dombois and Ellenberg 1974, Rowe 1984, and Strong *et al*. 1990).

Early twentieth century ecologists who favored a strict floristic system included members of what has been termed the Zurich-Montpellier Tradition in central Europe (see Shimwell 1971). The most well known among them is Braun-Blanquet (1928, 1932, 1951), whose work established a formal approach to the floristic classification of vegetation. The Braun-Blanquet system has been explained in detail by Poore (1955), Becking (1957), Whittaker (1962), Mueller-Dombois and Ellenberg (1974), and Westhoff and van der Maarel (1973). Initially, floristic data (composition and cover of species) are collected from stands using plot methods. The plot, a relèvé, is placed in an area of the stand that is considered to be representative of the vegetation of the entire stand. The plot data are then compiled into tables (species by plots), and the species are sorted to identify those that co-occur in certain patterns. Based on this analysis of the plot data, stands can be grouped into associations. The associations can then be compared to one another to determine which groups of species best exemplify the association, either by being dominant or restricted to the association.

Species that are common to several associations can be used to assemble the associations into broader groups. For example, the Braun-Blanquet approach groups plant associations with common diagnostic species into units called "alliances." In this way associations can be arranged into a hierarchy based on floristic composition. Mueller-Dombois and Ellenberg (1974) note that the association concept has become more narrowly defined as more information is gathered in a region. They consider the alliance level, where species with more widespread distribution are used to identify groupings, a more easily defined unit at the regional level and useful for orientation with respect to floristic composition.

Ecologists in northern Europe initially emphasized floristic differences between the vegetation layers rather than the overall floristic list, but they subsequently adopted an approach similar to that of Braun-Blanquet (Whittaker 1962). In England, less effort was expended in formalizing the use of floristics, and more on basic description for the purposes of vegetation dynamics (Tansley 1939, Watt 1947). Recent efforts by Rodwell (1991) emphasized species constancy to define associations, and represents a substantial contribution to a fully developed floristic classification of British vegetation. Until recently, floristic classifications in the United States have only focussed on very local areas.

3.2.1.3 Potential versus Existing Vegetation

When identifying objectives for a classification, it is important to decide whether the classification is intended to portray existing vegetation or potential natural vegetation (PNV). Classifications emphasizing existing vegetation determine their vegetation units based on the current characteristics of the vegetation regardless of the stage of development. Stands are classified according to their characteristics at the time the sample is collected. The selection of the stands for sampling, however, may be weighted to those considered most natural.

Classifications emphasizing potential natural vegetation use vegetation characteristics that represent the most mature and stable endpoints of vegetation development. In the words of Tuxen (1956, in Mueller-Dombois and Ellenberg 1974), potential vegetation becomes "the vegetation structure that would become established if all successional sequences were completed without interference by man under the present climatic and edaphic conditions (including those created by man)." Thus the vegetation units are hypothetical units that are thought to indicate a site's potential for developing certain kinds of vegetation. These units are based on known current relationships between vegetation and site characteristics, such as soils or landform. They can be used to great advantage by land managers faced with a landscape where much of the vegetation has been removed. However, PNV units are limited by the current knowledge of vegetation-site relationships, and the ability of vegetation *per se* to infer site characteristics. They also emphasize hypothesized climax vegetation, a concept fraught with theoretical difficulties.

The best known portrayal of potential natural vegetation is that of Kuchler (1964), who mapped the potential natural vegetation of the United States at a scale of 1:3,168,000 and (in 1985) at a scale of 1:7,500,000. This map is limited in its focus to only mature types. Thus, for example, extensive natural stands of trembling aspen are not portrayed on the map because these are not considered climax types.

3.2.2 Site Classifications

3.2.2.1 Site Classifications Emphasizing Vegetation

Site classifications are intended to reflect the potential of a particular site to support various types of vegetation. A number of different site classification systems have used vegetation only to determine the site potential, usually with reference to successional trends or productivity. In this sense, these systems focus on potential natural vegetation.

Site classifications emphasizing vegetation have been developed in concert with the development of physiognomic and floristic classifications. Cajander (1909, in Shimwell 1971) noted how the same understory composition could occur under different canopy dominants in a system of "forest site types." He inferred that ground vegetation is more representative of site factors than are canopy dominants and worked with others to describe ecological series of communities along environmental gradients.

A widespread approach to site classification using vegetation is that of the habitat type classification system (Daubenmire 1952, Pfister and Arno 1980, Kotar *et al*. 1988). This system focuses on natural climax or near climax vegetation with an emphasis on all understory species as a faithful reflection of site characteristics. Relationships between vegetation and the soils or landform factors are established during and after the classification process, but these factors are not used to define the vegetation units (Komarkova 1983). The units described are natural ones, but the emphasis is on determining vegetation units that represent "ecologically equivalent landscapes" (Kotar *et al*. 1988). Insofar as they describe the floristic composition of part of the natural vegetation, namely climax stands, the units of the habitat type are fairly equivalent to the plant association concept (Komarkova 1983). The intent is to use these descriptions to visit sites that are not at climax and, by examining their understory composition, to infer their ecological potential.

Somewhat different from the habitat type approach is that of ecological species groups, which are species that show similar "ecological behavior." Generally these species belong to the same layer of vegetation (e.g., the herb layer, nonvascular layer, or shrub layer). The method presumes that communities are combinations of plant species whose composition is dependent on the local environment (Mueller-Dombois and Ellenberg 1974). The community unit identified can, at times, be very similar to the plant association level, whereby the ecological species groups are the diagnostic species for the association. However, it is also possible that the same association could contain several ecological species groups (Mueller-Dombois and Ellenberg 1974). The ecological species group information can either be used by itself to indicate site characteristics, in which case the system partially resembles the habitat type system, or it can be integrated with other measured site factors as part of an ecosystem classification (Pregitzer and Barnes 1982, Cleland *et al*. 1994).

3.2.2.2 Site Classifications Emphasizing Multiple Factors

Site classification systems that use multiple factors have as their focus the subdivision of land into major and minor land types or landscape ecosystems. They have been developed primarily for land managers who need to integrate resource management, biological conservation, and restoration planning. They are also used for comparisons of productivity, species distributions, and interactions. These systems are most appropriate for classifying ecosystems, defined by the dynamic interactions of the biotic and physical components. Ecosystems are treated as "layered, volumetric segments of the biosphere" (Barnes *et al*. 1982, Rowe 1984). As with vegetation classifications, emphasis is placed on units that are more or less homogeneous both as to form and structure, but in this case with respect to all factors of the land and the vegetation supported thereon (Rowe 1961).

An ecosystem approach to classification, namely that the plant community is considered together with its environment, was implicit in Clements work (1916), but was defined explicitly by Tansley (1935) and similarly by Sukachev (1945) as "biogeocoenosis." Central to the application of the approach is that all parts of the system are included. In some systems, each part—vegetation, soils, climate and landform - is first studied independently and then combined (Jones *et al*. 1983, Sims *et al*. 1989, Driscoll *et al*. 1984). For others, it is considered essential that the parts be combined at the outset, since it is their joint interactions on the landscape that define the units. It is difficult to bring together all of the multiple factors jointly beyond the local level and understand their interactions. Thus, the units are considered hypotheses in need of further testing (Albert *et al*. 1986). Mapping is a key step in the process (Rowe 1984, Zonneveld 1989). Bailey's ecoregional map of the United States (1976, 1994) is more like the independent approach, as he relies heavily on separate climatic, physiographic, and vegetation maps and then reconciles their boundaries. The work of Albert *et al*. (1986) and Cleland *et al*. (1994) represent more of the combined approach.

The biogeoclimatic zone system of Krajina (1965, in Mueller-Dombois and Ellenberg 1974) is another system in which vegetation is emphasized in defining landscape or ecosystem units. These zones are defined as geographic areas that are predominantly controlled by the same macroclimate and contain similar soils and (climatic climax) vegetation. The definition of the zones at lower scales utilizes vegetation units that are defined by the plant association concept (Pojar *et al*. 1987). At higher levels, climatic zones and topographic position are used to help group vegetation units into the biogeoclimatic zones.

3.2.3 Land Cover Classifications

Land cover classifications are primarily intended for land management or resource planning. They emphasize conspicuous features of the land surface, and can be combined with land-use maps to convey an overall perspective on what is visually present on the land. As such, they often rely on characters that can be seen by remote sensing images (Witmer 1978).

To a certain extent, land cover classifications can draw from units defined by physiognomic classifications (Anderson *et al*. 1972). For example, forest cover types are a "descriptive classification on forest land based on present occupancy of an area by tree species. They are named by characteristic dominants that recur over tens of thousands of hectares," (Eyre 1980). Since physiognomic units also emphasize the dominant features of the vegetation (see above), there is some overlap in perspective.

3.2.4 Combined Classification Approaches

There are many commonalities among these classification systems. For example, site classifications include considerable vegetation information that is collected in the same way that would be used for vegetation classification (Mueller-Dombois and Ellenberg 1974, Pregitzer and Barnes 1982). Similarly, habitat type classifications define plant associations in a similar manner to that of the floristic system of Braun-Blanquet. Furthermore, site classifications that bring together independent vegetation, soil, and landform classifications rely on the independent classification of these variables as their starting point (Jones *et al*. 1983, Sims *et al*. 1989).

3.2.4.1 Physiognomic–Floristic Approaches

The principle underlying physiognomic classification is that each specific life form has a strategy (Stearns 1976) which has been selected under similar ecological pressures, and that the composition of life forms in a vegetation type is governed by these strategies (Monsi 1960, Raunkier 1904, Walter 1973, Whittaker 1975). Since physiognomic attributes are borne by individual species, recognition of a physiognomic assemblage depends on the co-occurrence of species in a given area. The co-occurrence of species leads to specific physiognomic vegetation types that can be delineated as discrete units in the landscape. As such, the physiognomic types can be related to floristic classifications that include the total composition.

The advantages of the separate components of the physiognomic and floristic approaches to classifying vegetation have been presented above. An important reason for combining these approaches is that vegetation is most thoroughly described by both structure and floristic composition. Physiognomic systems are easily recognized in the field, can be applied with little knowledge of the flora, permit generalizations of vegetation patterns over large areas, and can be linked to remote sensing signals to facilitate vegetation mapping. These attributes allow the identification of patterns where little is known about an area, or more detailed survey is impractical. Floristic information, however, is almost always used for detailed site analyses, whether for studying environmental gradients, ecological site factors, or describing and forming classification units. Patterns of succession, disturbance, history (including paleo-ecology), and natural assemblages are better assessed through floristic composition than physiognomy.

A fully developed classification is most readily developed by combining physiognomy and floristics. This type of system allows the geographic orientation of physiognomic characters to be tied to the more local site specific information of the floristic characters. In combination, these systems can satisfy a broader range of objectives for use of the classification system. In particular, the combined physiognomic–floristic approach has the desirable attribute of producing mappable units with significant ecological meaning.

The rationale for such a coupling of systems has been developed over the years (e.g., Rubel 1930, Ellenberg 1963, Webb *et al*. 1970, Wergner and Spangers 1982, Westhoff 1967, Westhoff and Held 1969, Borhidi 1991). These studies have found a very good fit between floristic and physiognomic classifications of the same areas because both types of attributes are borne by

4.0 The Nature Conservancy's Vegetation Classification System

4.1 Approach of the Vegetation Classification System

4.1.1 Background

Over the past twenty years, The Nature Conservancy has developed a science-based approach to conserving biological diversity. The Conservancy's approach to conservation science relies on the consistent and systematic accumulation, management, and analysis of information on the "elements of biological diversity"— specifically the status and location of plants, animals, and ecological communities. This information is collected and managed by the Association for Biodiversity Information (ABI), an international network of cooperating Natural Heritage programs and conservation data centers.

For more than a decade, the Conservancy and the Natural Heritage programs have employed a "coarse filter/fine filter" approach to preserving biological diversity. This approach involves the identification and protection of ecological communities (coarse filter) as well as rare species (fine filter). The protection of the best examples of all ecological communities will assure the conservation of most species, biotic interactions, and ecological processes. Those species that "fall through" the community filter are generally the rare species. Identification and protection of viable occurrences of rare species serves as the fine filter for preserving biological diversity (Jenkins 1976, Hunter 1991). Using communities as a coarse filter has ensured that the Conservancy is working to protect a more complete spectrum of biological diversity, not just those species whose priority conservation status has been documented.

Ecological communities were first used to help direct conservation priorities on a state-by-state basis. Community information was systematically collected by ecologists from the state Natural Heritage programs to develop and refine state-level community classifications and conservation ranks. These state classifications were developed for most states, but often used different classification approaches (White 1978, Nelson 1985, Reschke 1990). This strategy to identify conservation priorities was implemented at the state level to assure protection of ecological communities. However, national conservation efforts require compilation and analysis of community data from a rangewide perspective.

A major obstacle to using communities as conservation units at the national level was the lack of a consistent national vegetation classification system[1]. To overcome this problem, the Conservancy, in conjunction with the ABI, has developed a standardized hierarchical system to facilitate the identification and classification of vegetated terrestrial communities across the United States.

4.1.2 Guiding Principles

4.1.2.1 Appropriate for Conservation Planning and Management

The Conservancy's national vegetation classification system was primarily developed for the purposes of conservation planning and biodiversity protection. The intent of the classification system is to provide a complete, standardized listing of all communities that represent the variation in biological diversity and to identify communities that require protection. The classification will be consistent throughout the United States at appropriate scales for conservation planning and the management and long-term monitoring of ecological communities and ecosystems. It is also intended to have applications as a vegetation data layer for mapping and landscape and ecosystem analyses.

4.1.2.2 Efficient Use of Existing Information

Because The Nature Conservancy's mission is to protect biological diversity, the classification system emphasizes biota as the major attribute. Vegetation is the primary attribute used to classify terrestrial communities. When designing the classification system, the existing standards for vegetation classification and characterization were recognized and used wherever possible (see Section 3.0 above). Various classification systems were researched that had national or international applications, used widely accepted standards, and were practical for conservation applications. Several widely accepted classification approaches were adapted and modified as necessary to meet conservation objectives. When identifying individual vegetation types within the classification system, vegetation types from existing classification schemes were analyzed and refined to bring them to a common and consistent scale.

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[1] The terms "classification system," "classification scheme," and "classification approach" refer to the approaches used to classify communities (i.e., "The classification system is hierarchical"). The term "classification," used as a noun, refers to a list of communities arranged according to their relationship to one another (i.e., “The classification contains more than 3,500 communities”).

To efficiently use existing community information across the United States, the relationships between communities in the Conservancy's classification and those from other classifications must be documented. As no single system will be completely compatible with all other classification systems, the intent was to build this system and then create cross-references to other classification schemes as needed (see Section 5.6.1 for an example). Numerous data fields are included in the ecological database records to identify these relationships (see Section 4.3.1.2 below). These features were designed to help The Nature Conservancy utilize the information in other systems as well as to help the users of other systems to understand how their classifications fit into the Conservancy's system.

4.1.2.3 Flexible

In addition to meeting the objectives for protecting biological diversity, another goal of the classification system is to meet the objectives of other federal and state agencies, academic institutions, and other conservation organizations involved in the science and practice of conservation and ecosystem management. Recognizing that the objectives for using a national vegetation classification vary among these groups, the classification system was designed to be as flexible as possible while maintaining certain standards. For example, the system is open ended — new classes can be added as needed, provided they follow the guidelines developed for the classification system. In addition, information not explicitly used to classify vegetation can be incorporated as attributes in associated data records, maps, and reports (see Sections 5.4.3 and 6.2.2 below). The classification is also meant to be updated and refined as further inventory and classification efforts provide additional data and knowledge about the vegetation.

4.1.2.4 Emphasis on Natural and Seminatural Vegetation

For purposes of prioritizing classification research, the existing vegetation types have been categorized to reflect their level of disturbance and management. "Natural," "seminatural," and "modified" vegetation types are recognized to reflect differences in the natural and anthropogenic disturbance regimes. In addition, a "cultural" land cover class is recognized which includes anthropogenic vegetation types (e.g., lawns, crops) and structures (e.g., buildings, parking lots). All of these classes can be described within the Concervancy's classification system. These distinctions, while somewhat arbitrary, have been used to categorize the landscape and focus conservation efforts on the more natural types. However, in mapping vegetation, all vegetation types and land cover classes must be portrayed under a single classification approach (see Section 5.2.4 below).

4.2 Development of the Nature Conservancy Classification System

4.2.1 Identification of Classification Units

The classification units defined thus far have been primarily developed from existing vegetation data collected by state Natural Heritage programs from federal agencies, researchers, and from vegetation data or summary descriptions reported in the literature. Thousands of references and unpublished data sets have been reviewed and analyzed to create the classification units. However, there is considerable variation among states in the amount of community information available and the degree of development of the state classifications. The degree of development of the national classification on a state-by-state basis reflects the amount of information available (see Section 5.7.1 below).

The classification process is implemented through a variety of qualitative and quantitative means depending on the amount and type of information available. The classification is continually refined and updated as additional field data are collected and analyzed. The development of the national vegetation classification has proceeded from the development of state classifications to the production of regional classifications, and finally to the generation of a consistent classification at the national level.[2] Although the state classifications vary widely in the level of detail and classification approach, each region has cross-referenced its respective state communities within the national hierarchical framework. Problems of scale and nomenclature continue to be rectified at the regional level in close association with the state ecologists.

The Conservancy is comprised of four regions that support Natural Heritage programs in the United States: west, midwest, east, and southeast (Table 1). Each of the Conservancy's U.S. regions has now completed a regional vegetation classification which employs the standards developed for the national vegetation classification (Allard 1990, Bourgeron et al. 1994, Faber-Langendoen 1993, Sneddon et al. 1992).

[2] The national classification does not currently include the full set of community information from Alaska or Hawaii. These states have well-developed classifications that will soon be incorporated into the national classification system.

Table 1. The Nature Conservancy Heritage Program Support Regions

East	Southeast	Midwest	West
Connecticut	Alabama	Illinois	Alaska
Delaware	Arkansas	Indiana	Arizona
Maine	Florida	Iowa	California
Maryland	Georgia	Kansas	Colorado
Massachusetts	Kentucky	Michigan	Hawaii
New Hampshire	Louisiana	Minnesota	Idaho
New Jersey	Mississippi	Missouri	Montana
New York	North Carolina	Nebraska	Nevada
Pennsylvania	Oklahoma	North Dakota	New Mexico
Rhode Island	South Carolina	Ohio	Oregon
Vermont	Tennessee	South Dakota	Utah
Virginia	Texas	Wisconsin	Washington
West Virginia			Wyoming

4.2.2 International Efforts

The classification system is applicable worldwide. Conservancy ecologists are currently working with the ecologists in conservation data centers in Canada to employ the classification system in British Columbia, Manitoba, Saskatchewan, and Ontario. Previous versions of the system have also been applied in Jamaica and Belize. Although the specific classification units have not been identified for other countries, the classification system is developed with the expectation that it will become an international standard.

4.2.3 Support from Federal and Academic Partners

Development of this classification system has been supported by a number of federal and academic partners who have interest in using the system. Support has been provided to the Conservancy's national and regional offices as well as directly to state natural heritage programs. A summary of the support granted to the Conservancy's national and regional offices is provided below. In addition, federal agencies, such as the Bureau of Land Management, United States Forest Service, the Environmental Protection Agency, and the National Park Service, have provided support directly to state natural heritage programs for community classification and inventory. This funding has been critical to the development of the national vegetation classification.

4.2.3.1 United States Geological Survey

The United States Geological Survey's Gap Analysis program has supported the development of the "alliance level" units (see below) in the eastern and western regions of the Conservancy and is planning to support the similar work in the southeastern and midwestern regions. The Gap Analysis program uses the alliance level of this classification system as the standard for their vegetation maps at scales of 1:500,000 to 1:100,000 (depending on the region) across the United States.

4.2.3.2 United States Fish and Wildlife Service

The United States Fish and Wildlife Service has supported the development of a list and descriptions of all of the known rare communities of the conterminous United States through their Land Acquisition Priority System (LAPS) (Grossman et al. 1994). Rare communities are among the measures of biological diversity that make up the LAPS "Biodiversity Target," a system that helps determine priorities for the acquisition of new refuges.

Individual refuges have also supported development of the classification. For example, the Stillwater Wildlife Refuge in Nevada supported ecologists in the Conservancy's western region to develop a classification for the refuge.

4.2.3.3 United States Forest Service

Region 8 of the U.S. Forest Service has worked with the Conservancy for several years to develop a classification and description of and keys to existing vegetation for the national forests in the region. In addition, the Conservancy is working with Region 1 of the Forest Service to develop data management and analytical tools to support vegetation classification and ecosystem characterization.

Several USFS regions have supported the Conservancy to crosswalk the USFS ecological land classification with the Conservancy's vegetation classification and further expand the classification. For example, the Conservancy and Region 9 of the USFS are working together to complete a analysis of their Research Natural Areas using a combination of the USFS ecological land classification and the Conservancy's classification. Similar work is in progress with the

USFS Northeast Forest Experiment Station in New Hampshire and in the Shawnee National Forest in Illinois.

Several individual USFS ecologists have collaborated with Conservancy ecologists to develop the Conservancy's classification in the Conservancy's western region. Ecologists from USFS Regions 3 and 4 collaborated with Conservancy ecologists to relate their habitat type classification to the Conservancy's classification. They also provided data and reviewed drafts of the classification.

4.2.3.4 National Park Service

In the Conservancy's southeastern region, the National Park Service is currently supporting the generation of vegetation maps for five small national parks using the regional portion of the Conservancy's classification. This project was initiated prior to the more comprehensive program to map the vegetation of all national parks and will be coordinated with the larger effort.

The National Park Service also funded the Conservancy to do a literature review to support the development of the classification of the vegetation in the Colorado Plateau, Utah.

4.2.3.5 Environmental Protection Agency

The Environmental Protection Agency's Environmental Monitoring and Assessment Program (EMAP) is using this classification system as the vegetation standard for their land-use maps. Region 5 of the EPA is supporting the Conservancy to apply the midwestern portion of the Conservancy's classification system to the vegetation of Wisconsin.

EPA's Region 7 is currently funding the Conservancy to synthesize vegetation data from states in the Great Plains using the midwestern, western, and southeastern portions of the Conservancy's national vegetation classification.

EPA Regions 1 and 3 are funding a coordinated effort by the Conservancy and state natural heritage programs to inventory and classify selected rare wetland communities in the eastern United States.

4.2.3.6 Inter-agency Groups

The Upper Great Lakes Biodiversity Committee is a group of federal and state agencies, academics, industry, and nonprofit environmental organizations in Michigan, Wisconsin, and Minnesota working to complete a regional biodiversity assessment. The assessment will include use of the Conservancy's classification system.

4.2.3.7 Academic Partners

The Nature Conservancy works closely with the Vegetation Section of the Ecological Society of America. ESA has now initiated a special panel on vegetation classification, where we will work in partnership to develop standards and a review process for the future development and refinement of the national vegetation classification system. Conservancy ecologists also collaborate with individual vegetation scientists to generate portions of the classification and solicit peer review.

4.3 Tools and Methods that Support the Documentation and Development of the Classification

4.3.1 Field Sampling

The Nature Conservancy utilizes standard methodologies for the collection of field data (Bourgeron et al. 1991, Sneddon 1992, Faber-Langendoen 1993). These methods apply to vegetation mapping (see Field Methodology report in this series) and the development of the vegetation classification and descriptions.

The field sampling methodology is usually based on the collection of plot/relevé samples of appropriate size and shape for the particular vegetation type being classified (e.g., square 10x10m plots are used to collect information on shrub-land communities, rectangular plots are generally used to collect information in riparian habitats). Within the plot, standard information is collected on the identity and abundance of all plant species, the structure/architecture of the vegetation, and a set of variables such as moisture regime, soil type, depth, organic content and pH, bedrock type, topographic setting, aspect, slope, geographic location, and others that characterize the immediate environment.

Given the extensive area covered by the classification, two methods, community-based and site-based, are commonly used to allocate samples. Community-based sampling is used to refine the classification for a targetted group of related communities. Site-based sampling is used to identify and classify the communities on a given site by identifying units which are representative of the biological associations across the major environmental gradients.

In community-based sampling, data collection is focused on a particular alliance or broader group of related communities of interest and a detailed set of criteria for site inclusion are determined a priori. For example, if sampling "fens" across six New England states, the sampling might be restricted to communities which (1) are dominated by graminoids or shrubs, (2) occur in areas of similar ecological setting (e.g., shallow to deep peat areas influenced by contact with basic groundwater), and (3) contain at least some members of a larger set of suspected characteristic species. In practice, restrictions are redefined as more is learned about the vegetation patterns.

In contrast to the community-based stratification, site-based stratification partitions the area of interest into units that reflect important environmental and topographic gradients (e.g., slope, aspect, elevation, moisture regime, soil type) (Gillison and Brewer 1985, Austin and Heyligers 1989). Transects that contain the strongest environmental gradients in a region are selected in order to optimize the amount of information gained in proportion to the time and effort spent during the vegetation survey (Austin and Heyligers 1989). Once the major environmental gradients are identified, they are partitioned into environmental cells that reflect unique combinations of the variables. Aerial photo analysis is used to further partition the units into areas of apparently homogenous vegetation. A subset of the cells that represent the entire range of variation of the site (wet-dry, low elevation-high elevation, disturbed-undisturbed, etc.) are then selected for sampling.

Once sample sites are located (by either community-based or site-based methods), plots are placed in areas of homogenous vegetation which are determined to be representative of the vegetation type. Regions of transitional nature are avoided. Random, restricted random, and stratified random schemes are all used to locate the plots within a site, though stratified random schemes are generally preferred. Because the objective for sampling is the characterization of vegetation types, the analysis methodologies are quantitative rather than probabilistic, and the defined units are scale-dependent. The representative placement scheme is substantially more efficient than other methods and appropriate for these objectives.

4.3.2 Community Descriptions

4.3.2.1 Characterization Variables and Vegetation Keys

The Nature Conservancy describes communities in the classification using a standard set of more than 100 characterization variables. Fields of information that can be completed for each community element include variables which portray the physiognomic and biotic traits of the vegetation, as well as variables that relate to key environmental factors, dynamic processes, landscape relations, community variability, threats, and management and protection needs. Cross-references to other major classifications, including the Federal Geographic Data Committee's classification standard, are included in the fields used to characterize the community elements.

On local and regional levels, complete community descriptions can be converted into vegetation keys so that users of the classification can identify occurrences of the community on the ground. National-level keys will not be possible until the classification is more complete.
While all of the fields can be used to describe a given community, such complete characterization is beyond the scope of many projects. As a result, the Conservancy has identified a minimum subset of the fields that provide a satisfactory description of a vegetation type (Table 2). Examples of basic community descriptions are included in Appendix 9.2.

Table 2. Minimum Set of Fields for Community Descriptions

- Scientific name
- Common name
- Synonym
- System
- Physiognomic class
- Physiognomic subclass
- Formation group
- Formation
- Alliance
- Classification confidence level
- Range
- Environmental description
- USFWS wetland system
- Strata
- Most abundant species
- Diagnostic species
- Vegetation description
- Other noteworthy species
- Conservation rank
- Rank justification
- Comments
- References

4.3.2.2 Biological and Conservation Data System Community Records

Community characterization variables have been captured in a database system, the Biological and Conservation Data System, in which heritage information is managed. These files contain both data fields (single- and multi-valued) and summary fields (text) which carry information on individual occurrences (stands) of communities (Element Occurrence Record) as well as the general descriptions of the vegetation type across its range (Community Characterization Abstract). Information on communities carried in these files includes a basic description of the vegetation, its physiognomic structure, and biotic composition. Also included is information on the key environmental factors, dynamic processes, landscape relations, community variability, threats, and management and protection needs associated with each community. Fields that identify the relationship of the community to communities from other major classifications are included in the data structures. This supporting information allows the classification of each type to be documented and occurrences of types tracked by state heritage programs. Brief descriptions of the fields in the Element Occurrence Record and the Community Characterization Abstract are included in Appendixes 9.4 and 9.5.

4.3.3 Conservation Ranking

After a community's type is recognized, it is ranked according to its relative rarity or endangerment. Individual occurrences of each community type are also ranked according to their relative condition. The combination of classification and ranking systems provides a framework for identification of the most significant community types and community occurrences, a critical step in identifying priority sites for biodiversity conservation.

Communities are ranked on a global, national, and subnational (state or provincial) conservation scale of 1 to 5 in a manner similar to the system developed by The Nature Conservancy for ranking species (Master 1991). A rank of G1 (Global 1) indicates that a community is highly endangered due to rarity, endemism, and/or threats, and a rank of G5 (Global 5) indicates no risk of extinction. Similarly, a rank of N1 (National 1) or S1 (Subnational 1) indicates that the community is endangered at the national or subnational level, respectively. The two primary criteria in determining a community's rank include total number of occurrences and total area (acreage) of the community rangewide. Measures of geographic range, trends in status (expanding or shrinking range), trends in condition (declining condition of remaining acreage), threats, and fragility are secondary ranking factors which are considered when assigning a rank. The criteria used to assign a rank to a particular community are documented using a standardized format. See Appendix 9.6 for a description of Element Ranking Criteria.

In a fashion similar to ranking of community types, the occurrences of a particular community are ranked using a scale from "A" to "D." These community occurrence ranks are based on the occurrence's relative condition, size, quality, viability, and defensibility. "A" ranked community occurrences are generally large, pristine examples of the community type with relatively little disturbance and no threats, whereas "D" ranked occurrences are generally small, highly degraded, threatened examples of the type which may not be "protectable."

5.0 A Standard National Vegetation Classification System

It is proposed that the vegetation classification system developed and implemented by The Nature Conservancy be further refined for use in the NPS/USGS Vegetation Mapping Project as the standard for a national vegetation classification system. The national vegetation classification system proposed below is reviewed by specifications for a national vegetation classification standard and specific NPS/USGS program objectives. Further recommendations for the refinement of the proposed system will be considered throughout the project, and modifications will be implemented as appropriate. Additional recommendations will be generated during the pilot applications of this system in the field.

5.1 Characteristics of the National Vegetation Classifications System

5.1.1 Based on Existing Vegetation

The national vegetation classification system focuses on existing vegetation rather than potential natural vegetation, climax vegetation, or physical habitats (see Section 3). The vegetation types covered in the classification range from the short-lived to relatively stable and persistent plant communities. The classification includes natural, seminatural, modified, and cultural vegetation. The temporal and spatial variation in communities is an intrinsic property of the vegetation itself and, therefore, critical to the protection of biodiversity and landscape dynamics. Not restricting the classification to stable vegetation types ensures the units are appropriate for inventory and site description, and provide the level of detail required to build ecological and landscape models.

5.1.2 Combined Physiognomic–Floristic Classification Approach

The national terrestrial vegetation system is hierarchical and combines physiognomy at the highest levels of the hierarchy and floristics at the lowest levels. This classification approach was chosen to allow the characterization of vegetation patterns at multiple scales. The combined physiognomic floristic system allows identification of units from both a divisive ("top-down") and agglomerative ("bottom-up") approach. The top-down approach allows the use of physiognomic distinctions to help map vegetation, to stratify sampling, and, where floristic information is lacking, to delimit vegetation units. The bottom-up approach requires that plot sampling and floristic analysis are the primary means for defining communities. Where physiognomy is variable, the bottom-up approach can also be used to help determine the important physiognomic distinctions.

The basic unit of the vegetation classification is the "community element" which is defined as an individual plant association or repeating complex of plant associations. These associations have definite floristic composition, uniform physiognomy, and represent uniform habitat condition (see Flahault and Schroter 1910). The community element concept is similarly related to the plant association concept used in the Zurich-Montpellier tradition (see above). These floristic units are characterized as patterns of co-occurring species that recur either in space or time under similar environmental conditions.

In the field, community elements are recognized as structurally and floristically homogeneous stands of vegetation that occur in a relatively uniform environmental setting. As a result of the individual species distribution patterns (the continuum concept) and the environmental complexity across the landscape, there is considerable variation within a community type across environmental gradients and the landscape. The vegetation communities can be defined as homogeneous stands of vegetation on the ground, but individual occurrences of a particular plant association will vary in species compositions and structure.

The floristic units are arranged under a hierarchy based on physiognomic characteristics of their dominant vegetation. This physiognomic hierarchy is a modification of UNESCO (1973) and Driscoll, *et al*. (1984), and utilizes the physical form of the dominant vegetation to organize the floristic units (see below).

5.1.3 Role of the Environment

An underlying assumption of national vegetation classification system is that vegetation is the best and most easily measured assimilator of complex environmental and historical site conditions. Although the classification units are defined by vegetation only, the concept of a community as an ecological unit includes all the biological and physical diversity associated with that specific vegetation type. For example, a herbaceous woodland "serpentine barren" plant community (scientific name: *Pinus [virginiana, rigida]/Schizachyrium scoparium* alliance) actually describes the unique geologic setting in which it is found, the rare insects associated with the vegetation, and the fire disturbance history that maintains the community.

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[1] Structural uniformity is assessed by evaluating all layers of the vegetation, not just the canopy. Floristic homogeneity is assessed by evaluating the general uniformity and consistency in species composition, especially with respect to the dominants (Mueller-Dombois and Ellenberg 1974).

The community elements of the national vegetation classification system are related to a set of environmental factors rather than to a particular site. This ensures a consistent ecological meaning for the community level of the classification across a broad geographic range. Environmental parameters are measured with the floristic units to develop this correlation with the ecological reality. When the classification is mapped across a site, the distribution of community elements provides a basis for interpreting the ecological and land use processes across the landscape.

5.2 Description of the Levels of the Terrestrial Vegetation Classification Hierarchy

The national vegetation classification system has seven levels. The top level of the hierarchy identifies whether the community is terrestrial, aquatic, or subterranean. For the classification of natural and seminatural terrestrial vegetation, the next four levels describe physiognomic characteristics, and the last two levels describe the floristics. The levels are

- System
- Physiognomic class
- Physiognomic subclass
- Formation group
- Formation
- Alliance
- Community element

5.2.1 System Level

The top division of the classification hierarchy separates vegetated communities (Terrestrial System) from those of unvegetated deep-water habitats (Aquatic System) and unvegetated subterranean habitats (Subterranean System). The Terrestrial System of the national hierarchy is very inclusive. It includes the vegetation of uplands, the emergent and rooted submerged vegetation of lakes, ponds, rivers, and marine shorelines, and the sparsely vegetated and nonvegetated communities. In relation to Cowardin *et al*. (1979), this system includes those portions of the palustrine, lacustrine, riverine, estuarine, and marine systems that have rooted vegetation.

Communities of the Aquatic System lack rooted vegetation and are generally described as having fish, macroinvertebrates, algae, and corals. The Aquatic System includes the nonvegetated (faunal) and vegetated communities of the Cowardin *et al*. (1979) marine, estuarine, riverine, and lacustrine systems beyond the limits of rooted vegetation. The Subterranean System includes terrestrial cave communities which are generally described using the dominant fauna.

There are different hierarchical divisions below each of the three systems. The hierarchy for the Terrestrial System is structurally complete. It has six levels, with four physiognomic levels (physiognomic class, physiognomic subclass, formation group, and formation) and two floristic levels (alliance and community element). The hierarchical levels of the Aquatic and Subterranean classification systems are in different stages of development, and the marine component is also near completion.

For the purpose of the NPS/USGS Vegetation Mapping Project, the Aquatic System (e.g., freshwater streams and rivers, lakes, reservoirs) will be classified and mapped at a coarser level of detail than the communities in the Terrestrial System (see Section 5.2.4.2 below).

5.2.2 Physiognomic Levels

The physiognomic portion of the national vegetation classification hierarchy is a modification of the UNESCO world physiognomic classification of vegetation (1973) and incorporates some of the revisions made by Driscoll *et al*. (1984) for the United States.

The UNESCO vegetation classification system uses physiognomy (outward appearance) and structure of the vegetation to define the units. It is intended to provide a comprehensive framework for the preparation of vegetation maps at a scale of 1:1 million or smaller. The system was designed to include all natural and seminatural vegetation, but "cultural" vegetation (wheat fields, vineyards, etc.) is not included.

The UNESCO physiognomic system was incorporated as the physiognomic base for the hierarchy for the following reasons:

- It is one of the few classification systems already in place that could be employed with relatively little research and development cost.

- It is already the product of an international group of experts. As a result, it is worldwide in coverage and a more readily acceptable product than local and single-authored systems. Parts or variants of the system are presently being used by different United States and international agencies.

- It is ecologically meaningful.

- It is a hierarchical system that was designed for classification and mapping at multiple scales.

- The structure of the system makes it open-ended; units can be added as needed.

5.2.2.1 Modifications to the UNESCO Hierarchy

The UNESCO system has now been modified and refined to provide greater consistency at all hierarchical levels and includes additional physiognomic types. Several limitations of the UNESCO hierarchy prevented an unmodified application to the national vegetation classification system. As an example, there was little supporting information to explain the criteria used to define each hierarchical level. In addition, the same criteria were used at different levels to define the units. Finally, there were several vegetation formations, such as wetlands, that were not adequately represented in the original UNESCO system.

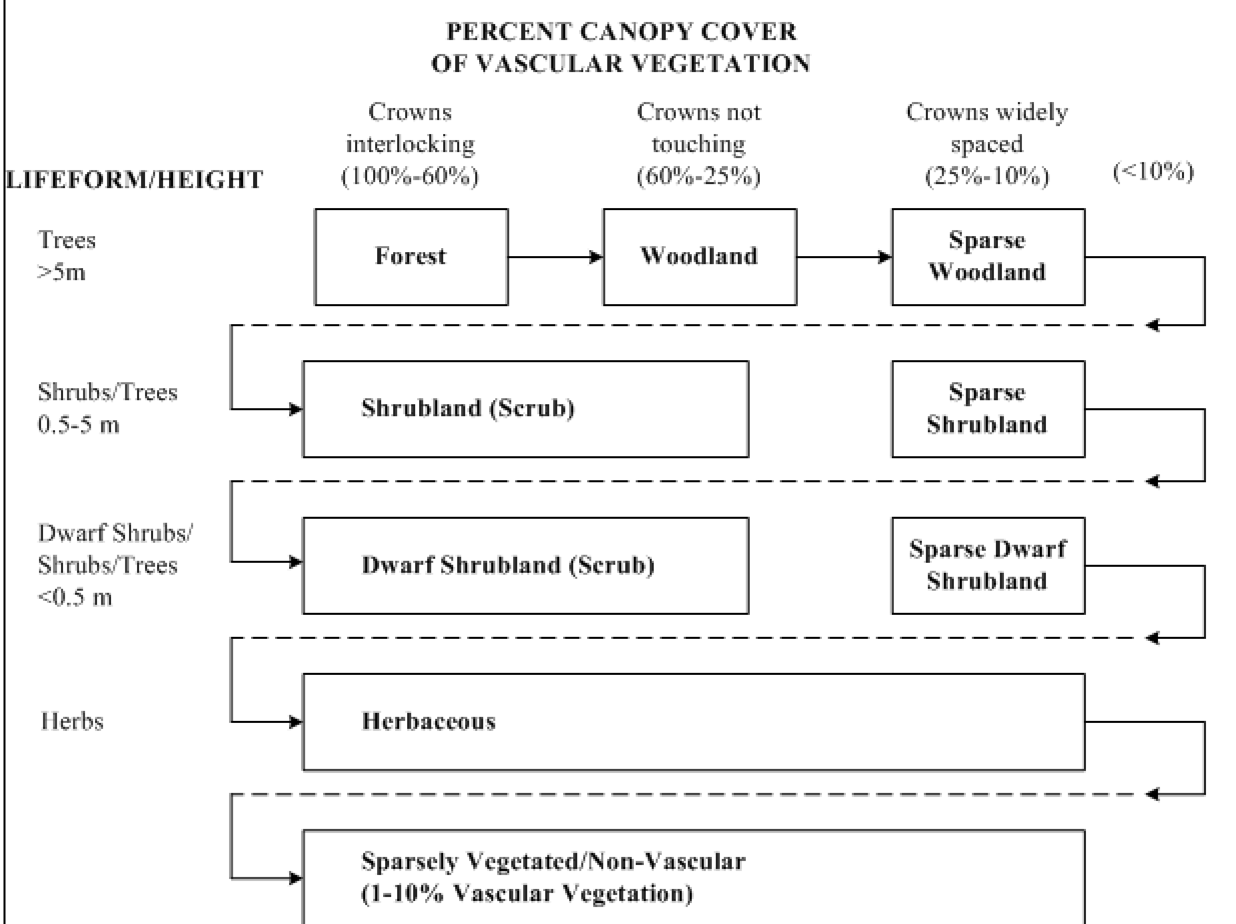
In particular, the "subclass level" of UNESCO has been modified to better conform to the Federal Geographic Data Committee's standards for vegetation classification. The UNESCO system has also been adjusted by including more explicit hydrological modifiers at the formation level. The hydrologic modifiers introduced by Cowardin *et al*. (1979) were explicitly adopted since these have been used extensively to map wetlands across the United States (Appendix 9.3). The levels are outlined in the following sections. See Appendix 9.1 for a complete version of the hierarchy.

5.2.2.2 Physiognomic Class

The Physiognomic Class is based on the structure of the vegetation. This is determined by the height and relative percentage of cover of the existing tree, shrub, dwarf shrub, and herbaceous strata (Figure 1). This level has nine mutually exclusive classes:

Forest	Woodland	Sparse Woodland
Shrubland	Sparse Shrubland	
Dwarf Shrubland	Sparse Dwarf Shrubland	
Herbaceous	Sparse Vascular/Non-Vascular	

Figure 1. Percent Canopy Cover of Vascular Vegetation



5.2.2.3 Physiognomic subclass

The Physiognomic Subclass is determined by the predominant leaf phenology of classes defined by a tree, shrub, or dwarf shrub strata (evergreen, deciduous, mixed evergreen-deciduous), the average vegetation height for types defined by the herbaceous stratum (tall, medium-tall, short), and particle size of the substrate for sparsely vegetated and nonvascular communities (e.g. consolidated rocks, gravel/cobble, sand accumulations, mud flats).

Examples:

- Evergreen forest
- Deciduous forest
- Mixed Evergreen–Deciduous forest
- Tall grassland
- Medium-tall grassland
- Short grassland
- Sparsely vegetated sand accumulations

5.2.2.4 Formation Group

The units for the Formation Group are based largely on a combination of climate, leaf morphology, and leaf phenology. In addition to climate and leaf characteristics, the groups for the sparse woody classes (i.e., sparse woodland, sparse shrubland, and sparse dwarf shrubland) are defined by the dominant lower stratum.

Examples:

- Temperate evergreen needle-leaved woodland
- Broad-leaved evergreen sparse shrubland with a dominant herbaceous stratum
- Polar short grassland

5.2.2.5 Formation

The Formation represents an ecological grouping of vegetation units based on broadly defined environmental factors such as elevation and hydrologic regime, and additional structural factors such as crown shape, and life-form of the dominant lower stratum.

Examples

- Tropical or subtropical seasonal montane evergreen forest

- Seasonally/Temporarily flooded medium-tall grassland
- Needle-leaved evergreen woodland with rounded crowns
- Broad-leaved evergreen sparse shrubland with tall graminoids

5.2.3 Floristic Levels

5.2.3.1 Alliance

The Alliance is a physiognomically uniform group of plant associations (see Community Element below) sharing one or more diagnostic species (dominant, differential, indicator, or character), which, as a rule, are found in the uppermost strata of the vegetation (see Mueller-Dombois and Ellenberg 1974).

The Alliance is roughly equivalent to the "cover type" of the Society of American Foresters (Eyre 1980), although it is not restricted to describing forest cover. The Alliance may be finer in detail than a cover type when the dominant species extend over large geographic areas and varied environmental conditions. The Alliance is also similar in concept to the "Series." Alliances, however, are described by the diagnostic species for *all* existing vegetation types, whereas series are restricted to climax types and are described by the primary dominant species (see Pfister and Arno 1980).

Examples

- *Acer rubrum — Liquidambar styraciflua* Forest Alliance
- *Pseudotsuga menziesii* Woodland Alliance
- *Juniperus osteosperma* Sparse Woodland Alliance

See Appendix 9.1 for the list of known Alliances in the United States.

5.2.3.2 Community Element

The Community Element is the finest level of the classification system. For the Terrestrial System, the community element is defined as an individual plant association or repeating complex of plant associations. These associations have definite floristic composition, uniform physiognomy, and represent uniform habitat condition (see Flahault and Schroter 1910, Third International Botanical Congress 1910). This basic concept has been used by most of the schools of floristic classification (Braun-Blanquet 1965, Westhoff and van der Maarel 1978). The plant association concept applies to existing vegetation regardless of successional status.

The definition of the community element can be clarified with the following points:

- "Habitat" refers to the combination of environmental conditions and ecological processes influencing the community.

- Uniformity of physiognomy and habitat conditions may include patterned heterogeneity (e.g., hummock/hollow).

- As a rule, community elements recur over the landscape.

- The scale of the community element varies. Among other factors, the variation is determined by the size and apparent homogeneity of the occurrences across the landscape, the amount of data that has been collected, and the interpretation of these data by the field experts.

- The community element may be composed of a complex of plant associations that constitutes a functioning ecological unit if the plant associations always occur together (e.g., prairie pothole).

- The terms "community element" and "plant association" are both used to refer to the community element.

The community element is differentiated from the Alliance level by additional plant species, found in any stratum, which indicate finer scale environmental patterns and disturbance regimes. This level is derived from analyzing complete floristic composition of the vegetation unit when plot data are available. In the absence of a complete data set, approximation of this level is reached by using available information on the dominant species, indicator species, and environmental modifiers.

Examples

- *Acer rubrum-Liquidambar styraciflua-Populus heterophylla* Forest
- *Pseudotsuga menziesii/Festuca idahoensis* Woodland
- *Juniperus osteosperma*/*Stipa comata* Sparse Woodland

See Appendix 9.2 for examples of community elements organized under the classification hierarchy.

5.2.4 Cultural Land Cover

5.2.4.1 Agricultural Land Cover

The national vegetation classification system classifies agricultural land cover using the Federal Geographic Data Committee (FGDC) Vegetation Subcommittee's recommended system for Cultivated Vegetation (Table 3). The FGDC system is still under development, and the national classification system will evaluate further changes that may be made to these classes.

Table 3. Federal Geographic Data Committee Classification of Cultivated Lands

Herbaceous
- Row crop
- Close grown

Shrub
- Fruit/Leaf/Nut shrubs
- Fruit vines

Tree
- Fruit and nut trees
- Christmas tree plantations

5.2.4.2 Urban Land Cover and Water

The national vegetation classification system presently classifies and maps urban land cover and water at a coarser level of detail than natural and seminatural vegetation types. The system employs the land use and land cover (LULC) classification system developed by Anderson *et al*. (1976) for attributing Urban and Water dominated land cover. Urban, or "built up" land, water classes are attributed at Level II of Anderson's system (see Table 4). Anderson's LULC system is a widely accepted system used throughout many federal, state and local agencies. It was developed for use with remote sensor data.

Table 4. Anderson's Land Use and Land Cover Classification System

This portion of the Anderson *et al*. system was adopted for the national vegetation classification system to map cultural land cover (Anderson *et al*. 1976).

Level I	Level II
1. Urban or Built-up Land	Residential
	Commercial and Services
	Industrial
	Transportation, Communications, and Utilities
	Industrial and Commercial Complexes
	Mixed Urban or Built-up Land
	Other Urban or Built-up Land
2. Water (nonvegetated portion)	
	Streams and Canals
	Lakes
	Reservoirs
	Bays and Estuaries

5.3 Nomenclature Standards

Each Alliance and community element is assigned a name based on the scientific names of the diagnostic species that have a high degree of constancy. To ensure consistency of plant species nomenclature, the plant species names follow the standards developed by Kartesz (1994). Provisional community names are updated as additional information becomes available.

In the Alliance and community element names, plant species used in the name occurring in the same stratum are separated by the "-" symbol, and those occurring in different strata of the vegetation are separated by the "/" symbol (e.g., *Quercus macrocarpa/Corylus cornuta-Corylus americana* Woodland). In those cases where the diagnostic species are unknown or in question, environmental modifiers or broad vegetation or geographic modifiers are used as placeholders until the diagnostic species become known with more certainty (e.g., *Pinus palustris-Pinus echinata/Schyzachyrium scoparium* Serpentine Woodland).

As a rule, the diagnostic species for Alliances are consistently present (constant) in the community elements within the Alliance and the diagnostic species for community elements are consistently present in occurrences of the community. There are, however, certain situations where a diagnostic species is not consistently present in community elements within an alliance or in occurrences of a community element. When this happens, the species that are not consistently present in the community element or occurrences are placed in parentheses. For example "*Pinus ponderosa-(Pinus flexilis)* Alliance" means *Pinus ponderosa* is present in most of the associations while *Pinus flexilis* is not.

Some alliances have also been documented in which the associations share two diagnostic species, but neither of the diagnostic species are consistently present in all associations. In this situation both of the diagnostic species names are put in parentheses. For example, "*Pinus (ponderosa-flexilis)* Alliance" means that both species are not necessarily present in all of the associations, but at least one of them is present.

5.4 Development of the National Vegetation Classification System

5.4.1 Development of the Floristic Classes (Alliances and Community Elements)

Development of the floristic classes (Alliances and community elements) is an iterative qualitative and quantitative process. The majority of the floristic units presently defined in the classification system are the result of rigorous qualitative assessments due to the lack of quantitative data. The long-term goal for the national classification system is the determination of all floristic units through the quantitative analysis of consistent plot data. Field data (species lists and environmental information) will be prioritized and collected over time in order to verify the classification of many provisional types.

5.4.1.1 Qualitative Assessment

Qualitative assessments of existing information are completed to identify and describe provisional community elements. This process includes the compilation of existing state classifications and vegetation information from the literature and other sources. The vegetation units are placed into the physiognomic hierarchy based either on qualitative or quantitative description of structure and species composition. Alliances and community elements are named and described based on the qualitative assessment of patterns of diagnostic species. Groups of ecologists are required to develop and review these classification units. Problematic classifications and high-priority elements are targeted as a focus for future data acquisition and quantitative analyses to refine the classification of these types.

5.4.1.2 Quantitative Analysis

The process of quantitative assessment of the floristic elements includes the compilation and assessment of existing stand table and summary data on the community element and related types across the entire range of occurrence. Collection of additional field data is often required to support a robust analysis of the community. The resulting classifications are then sent out for peer review by appropriate experts (federal, state, and academic ecologists). Throughout this process the goal is to ensure consistent quality control of the data and application of the quantitative techniques.

Stand and summary data appearing in journal articles and published and unpublished reports are used extensively for the development of community elements. For a reference to a particular plant association to be included in the analysis, its source must provide location information, description of methods, species lists and quantitative measure of species abundance values. Primary data are collected by the Natural Heritage network and other researchers on community types that are undersampled and of high priority. Data collection is carried out by Natural Heritage and Conservancy ecologists using a standard relevé methodology (Sneddon 1992, Bourgeron *et al*. 1991 and see above).

Compiled data are assembled into a single file and transformed mathematically to a common abundance scale. The element classification process is implemented using quantitative approaches of ordination, clustering, and correlation depending on the information available. Three multivariate analysis programs, TWINSPAN, DECORANA, and CANOCO, are particularly useful in examining the floristic patterns and their relationships to measured environmental variables (Hill 1979, Hill and Gauch 1980, ter Braak 1990).

Despite their utility in synthesizing large data sets, many of the analytical programs identify vegetation patterns that are statistically but not ecologically meaningful. The quantitative analysis to determine vegetation patterns must be carried out under the guidance and review of experts who have a practical understanding of the ecological relationships in the field.

5.4.1.3 Confidence Levels

Each community type is assigned a "confidence level" that is determined by the amount and type of information available and the analysis methods used to define it (Table 5). These confidence levels help to identify where additional information will be required for the refinement of the classification. As additional field data become available, the classification is updated and the confidence levels reevaluated.

Table 5. Confidence Levels Assigned to Each Community

Confidence levels are assigned to each community based on the type and amount of information used to classify the type as indicated below.

1 — STRONG
Classification is based on quantitative analysis of verifiable data (species lists and associated environmental information) collected in the field. Information is based on occurrences that can be relocated.

2 — MODERATE
Classification is based on qualitative assessment of published field data or field data that are of questionable quality, that include limited numbers of samples, or have not been quantitatively analyzed.

3 — WEAK
Classification is based on anecdotal information or community descriptions lacking data.

5.4.1.4 An Example of the Development of Floristic Classes — Pine Barrens

To refine the classification of pine barrens communities and help identify conservation and management priorities, The Nature Conservancy initiated a classification and mapping project at the Waterboro barrens in York County, Maine. This project involved the collection of data on all communities in a single pine barren site and relating these data to the information available on pine barren communities at a regional scale.

Local (Intensive) Analysis of a Single Pine Barren Site

Waterboro is an expansive pine barren site which occurs on sandy, nutrient poor, outwash soils in southern Maine (Harris 1991). The mosaic of communities that occur within the site exhibit a wide range of composition and structure. This reflects the complex of climate, terrain, hydrology and historical factors present at the site.

A set of stereo aerial photos was obtained for the Waterboro Barrens site. Boundaries of vegetation units were delineated on the photos using the criteria of texture (smoothness or coarseness of the image), tonal contrast, and topographic location (Avery 1977), and these boundaries were transferred to a 1" by 500' topographical map. Three 10 m x 10 m plot samples were taken from representative areas within each vegetation type identified from photointerpretation. Particular attention was paid to the pitch pine – scrub oak vegetation types. Within each plot, one nested 5 m x 5 m quadrat was used to sample the understory vegetation and two 1 m x 1 m quadrats were used for sampling herbaceous vegetation. Information collected for each plot followed The Nature Conservancy standards reviewed above (e.g., species composition and abundance, soil texture, slope). A preliminary community classification was developed from this information, and a community map of the site was produced.

Regional (Extensive) Analysis of Each Community Type

Plot data for each community type occurring within the Waterboro Barrens complex were then compared with data from similar communities across the region. The analysis of the pitch pine – scrub oak community, for examples, benefited from a large data set (224 samples) that was assembled from published (Olsvig 1980, Ollson 1979, Milne 1985, Patterson 1984, McIntosh 1959) and unpublished literature (Pesiri, Latham, Tucker, Seichab, Harris, State Natural Heritage Program field forms for Massachusetts, Connecticut, Pennsylvania, New Hampshire, and Rhode Island). Each sample was collected from a standard plot placed in a vegetation association exhibiting a canopy of pitch pine over an understory of scrub oak and contained lists and abundance of all species (bryophytes and lichens excluded). Each sample was transformed into a common, four-category abundance scale to normalize the data. An arranged species-by-sample table illustrating patterns of floristic association was produced using TWINSPAN (Hill 1979), and the floristic patterns were circulated widely among state ecologists for review. Based on the discussions and comments of the reviewers, the table was manually rearranged until an agreement was reached on the ecological meaning of the floristic associations.

For the pitch pine–scrub oak communities, the relationships between the floristic patterns and the ecological variables were examined quantitatively using CANOCO. Although the only consistent environmental data available for every sample were latitude, longitude and elevation, the CANOCO analysis confirmed that these variables explained a large proportion of the variation in the data. This was reconfirmed through a DECORANA ordination followed by a nonparametric correlation (Spearmans rank) between the axis scores and the environmental variables. A reassessment of the existing pine barrens literature, in light of the new classification scheme, was also very useful in elucidating the relationships between vegetation and environment.

This process was repeated for other communities found within the Waterboro Barrens complex until each sample was classified within the national context. The overall species composition and diagnostic species, associated environmental variables, typical structure, and the range of physiognomic expressions were examined and the distribution, range, and global rank of each community was determined. The information was then used to refine the classification attributes on the vegetation map with the regional classification names.

5.4.2 Arranging the Floristic Units under the Physiognomic Levels of the Hierarchy

Once defined, the floristic units are fit into the physiognomic structure of the hierarchy based on their physiognomic expression across all stands. In some cases, communities may exhibit different physiognomic expressions without a concurrent shift in species composition. In these cases, the physiognomic group is determined by the most common expression of the community as opposed to a theoretically stable expression. Where floristic and physiognomic groupings do not correspond, precedence is given to the floristic relationships over the physiognomic structure. Types that present more than one physiognomic expression are cross-referenced in the hierarchy.

5.4.3 Adding New Vegetation Types Identified during the Course of the NPS/USGS Mapping Project

The present classification is a dynamic product that has been developed through the continuous review of literature, communications with local and regional experts, directed field examinations, and some quantitative analyses. All of the units have been derived through consistent application of classification rules using available vegetation data and associated environmental information. The NPS/USGS vegetation mapping project will provide a large amount of additional information that will allow further refinement of the classification. The classification system will evolve to reflect the growing body of knowledge concerning the biology, ecology, and geography of the different vegetation types. Many new vegetation types may be added to the classification and some current types may be split into new types, while others may be lumped together.

For new types to be added to the classification, they must contain significantly different biotic composition, be associated with different environmental conditions, and be documented to recur across the landscape. They also must be compared to information on related types from a rangewide perspective to ensure it is not a local variant of a community already classified. For the NPS/USGS vegetation mapping project, suspected new types will be evaluated, qualitatively or quantitatively assessed depending on the level of available data.

It is the responsibility of The Nature Conservancy to review the process for the classification of all new types. The recent designation of a special Ecological Society of America panel for Vegetation Classification should provide assistance in the formal review of new vegetation types in the near future.

5.4.3.1 Qualitative Assessment

When a vegetation type is discovered that may be new to the classification, it will be reviewed using the process described above for qualitative assessment of the floristic classes (Section 5.4.1.1). New data collected for the suspected new type and any existing plot data from the park will be assessed by The Nature Conservancy regional ecologists. The type will be placed under the classification hierarchy and compared to the information available for closely related types. If the type is still suspected to be new, it will be described by the regional ecology staff. This description will be circulated to the state Natural Heritage ecologists, other regional ecologists, and other experts. If the experts agree there is sufficient reason to believe the type is new, it will be named and assigned a confidence level of "3 — weak" or "2 — moderate" depending on the amount of available data.

The information generated on the new type will be disseminated from the Conservancy regional ecologist to all field ecology and photo-interpretation teams in each of the parks that could potentially contain the new type. The photo interpreters will incorporate the new type into their photo-interpretation keys at the park level (if this has not been done already). New types will be reviewed by the experts, classified and described before the final maps are produced for the park in which it was discovered.

5.4.3.2 Quantitative Assessment

If there is significant interest or need to quantitatively assess a new vegetation type or group of types, the process described in Sections 5.4.1.2 and 5.4.1.3 will be followed. The literature and other sources of data (including existing plot data from parks) will be searched, and all available stand table data will be compiled and assessed. Additional primary data will be collected where necessary. The entire data set will be analyzed, and the results will be reviewed by the experts on the type.

5.5 Ecological Considerations and Variability

Plant communities need to be recognized over the entire range of environmental variability

(Austin 1991, Bourgeron *et al*., 1994). The identification of community elements is performed to identify distinct floristic patterns with a clear ecological meaning. Thus, an important step to the classification itself is the identification of ecological factors that determine the vegetation patterns. Vegetation types are characterized by the co-occurrence of individual species as constrained by environmental features (e.g., climate, geomorphic, and edaphic factors), the dynamics of biotic processes (e.g., immigration, emigration, competition), and disturbance. The relationship between these factors and the vegetation patterns is often complex. Interpretation of the ecological meaning of the units is completed, in part, through qualitative understanding of the ecology, and wherever possible the quantitative analysis of correlations between species and a set of environmental factors. To understand these relationships, the literature on community processes, plant demography, reproductive biology, physiology, geography, must be consulted.

5.5.1 Homogeneity

Although some ecologists have identified shortcomings in the restriction that plant associations must be defined from homogeneous units (Noss 1987), floristic and physiognomic uniformity has been generally widely accepted as a valid criterion in the definition of floristic units (Mueller-Dombois and Ellenberg 1974). The criterion for homogeneity is particularly important when sampling vegetation for use in numerical analysis. On the landscape, however, existing vegetation is often transitional in nature. As a rule the national vegetation classification system does not presently recognize transitional areas or ecotones between two types as distinct elements in the classification. Two special exceptions to the classification rules deserve explicit attention: community complexes and gradients.

5.5.1.1 Community Complexes

Communities often occur as a fine-grained mosaic of interrelated, but distinct, floristic associations. Classification of these community complexes can be problematic as many, especially those with intrinsic microtopographical variation, are inseparable in any definable or useful fashion. These situations may occur in both random unpatterned fashion or as small-scale patterned heterogeneity (e.g., hummocks and hollows in bog situations might share some species, but have largely different dominants). When these situations occur, the complexes of plant associations are defined as a single community element. In these cases the patterning is described as attributes of the community complex.

5.5.1.2 Gradients

The composition of most communities reflects the distribution of individual species over multiple environmental gradients (Austin and Smith 1989). Deciding the optimal place along the major gradients to partition the continuum of change is one of the fundamental questions of classification theory. While in some cases the data are naturally clustered, in others several possible divisions of the data are justifiable. The final choices as to where to draw the line between related communities are driven by interpretation of the patterns by field experts and the objectives of the research.

5.5.2 Disturbance

Disturbance processes have a profound influence on the character and composition of vegetation. Broad-scale natural disturbances such as hurricanes, fire, flooding, avalanches, and disease as well as chronic small-scale disturbances such as hydrologic variation, tree-fall, animal digging, and herbivory often explain the variations in existing vegetation better than many of the traditionally measured ecological factors. A number of anthropogenic disturbances, such as clearing, plowing, grazing, development, and nutrient enrichment, have also affected existing vegetation patterns. These anthropogenic disturbances may simulate natural disturbances, create entirely new disturbance regimes or alter natural disturbance regimes (e.g. fire suppression). Often only circumstantial evidence is available to estimate the disturbance regime associated with a particular vegetation type.

Some disturbances, whether natural or anthropogenic, can cause alterations in the structure and composition of an occurrence of a community. If the disturbance is severe enough to alter the structure and floristic composition of a community on the ground, the classification of that unit may change. Following a catastrophic fire, for example, a Jack Pine/Blueberry Forest (Scientific name: *Pinus banksiana/Vaccinium* spp. Forest) may become a Jack Pine (Northern Pin Oak)/Little Bluestem Sparse Woodland (Scientific name: *Pinus banksiana (Quercus elipsoidales)/Schizachyrium scoparium* Sparse Woodland).

In contrast, some disturbance regimes may alter the structure or composition only moderately and the community may still fall within the range of acceptable variation for the type. Since most communities are identified by groups of diagnostic species rather than single diagnostic species, small-scale disturbances that cause minor changes in the floristic composition of the type are often not severe enough to change the classification of the unit. For example, selective logging techniques may extract Jack Pine from occurrences of a Jack Pine/Blueberry Forest. If the rest of the species composition of the community remain, the loss of only the Jack Pine may not be enough to consider the community as a different type.

5.5.3 Succession

Successional stages are treated like any other existing vegetation type. Once the structure and composition of a community reaches a stable state that is physiognomically and floristically

different from its previous successional stage, it is considered a different community in the classification. In developing the classification, particular emphasis is placed on understanding how the species composition relates to a particular successional process.
Floristic analysis of many successional vegetation types can reveal that a type is an unusual physiognomic expression of an existing community element. In the eastern region, for example, the *Quercus ilicifolia* (shrub oak) thickets that develop in areas of frequent fire share an identical species composition with the *Pinus rigida* (pitch pine) – *Quercus ilicifolia* (scrub oak) barrens with which they typically occur. Both of these types are considered subcommunities of the major community element, though only the fire-maintained type does not contain unique species.

5.6 The Relationship Between the National Vegetation Classification System and Other Classification Systems

The national vegetation classification system was developed with the knowledge that it would need to be related to other major classification approaches. Cross-references to other major classification systems are currently being developed. In the southeastern United States, The Nature Conservancy is completing the classification, description, and keys to the national forests. Included in the description of each type is a list of the Society of American Foresters (SAF) Covertype (1980) with which it is associated. For example, the Longleaf Pine/Little Bluestem-Blazing Star Woodland from the national classification (Scientific name: *Pinus palustris/Schizachyrium scoparium-Liatris pycnostachya* Woodland) would be found within the "Longleaf Pine" SAF covertype. Additional crosswalks that are being documented include the Kuchler Potential Natural Vegetation classification (1975), the Classification of Wetlands, and Deepwater Habitats of the United States (Cowardin et al. 1979), Brown, Lowe, and Pase (1980), and others.

5.6.1 An Example of Crosswalking: The Relationship between the Brown, Lowe, and Pase Classification and The National Vegetation Classification System

The Brown, Lowe, and Pase system was developed for use in the southwest, with special emphasis on Arizona. A later version was expanded to include all of North America (Brown *et al*. 1979, 1980). The mechanics of crosswalking the Brown, Lowe, and Pase (1980) classification system to the national vegetation classification system have been completed for all of the communities that occur on the Gray Ranch site in New Mexico.

The Brown, Lowe, and Pase classification and the national vegetation classification system combine physiognomy and broad climatic patterns in the upper levels of the hierarchy, though the factors may be treated at different hierarchical levels. For example, both systems separate wetlands from uplands, but the Brown *et al*. system does this at the second level (Vegetation level) of the hierarchy whereas the national classification does so at the fourth level (Formation level). Both systems also identify coarse physiognomic classes such as forest, woodland, scrubland, etcetera. The Brown, Lowe, and Pase classification calls this level of the hierarchy the "Formation-type" and this is recognized as the "Class" level in the national classification. The major difference between the two systems is that the Brown, Lowe and Pase classification recognizes a Regional Formation or Biome level which is based on "distinctive evolutionary history within a given formation." These biomes tend to be centered in particular geographic regions or provinces (Brown 1982). The national classification does not make such regional distinctions. The national classification, which is physiognomic at the highest levels, is geographic only to the extent that physiognomy reflects local ecological factors.

The Brown, Lowe, and Pase classification has two floristic levels, both which tend to be coarser in scale than the national classification. The Series level of the Brown, Lowe, and Pase generally represents the dominant species at climax and are often named by the dominant genus (i.e., Pine series). This level is much broader than the Alliance level of the national classification. The lowest level of Brown, Lowe, and Pase (1980) system, called the association, is generally identical to the Alliance level used in the national classification. For example, Brown, Lowe, and Pase (1982) describe a *Juniperus deppeana* association that is equivalent to the national classification's *Juniperus deppeana* Alliance. In a few cases, Brown, Lowe, and Pase divided the vegetation into associations that correspond to one, or a related group of associations, from the national classification. For example, the national classification contains a single *Pinus ponderosa* Alliance which has roughly forty associations within it. One of the associations within the *Pinus ponderosa* Forest Alliance is the *Pinus ponderosa/Quercus gambelii* association. Brown, Lowe, and Pase describe two associations: (1) The *Pinus ponderosa* association, which is nearly equivalent to the *Pinus ponderosa* Alliance in the national classification except that it does not include *Pinus ponderosa/Quercus gambelii* types; and (2) the *Pinus ponderosa/Quercus gambelii* association, which is equivalent to the *Pinus ponderosa/Quercus gambelii* association in the national classification (Table 6).

Table 6. Example of a Crosswalk between the Brown, Lowe, and Pase Classification and the National Vegetation Classification System

The "<" and "=" symbols identify the relationship between the floristic units from each system.

BROWN, LOWE, AND PASE		NATIONAL CLASSIFICATION
Biographic Realm Nearctic		**System** Terrestrial
Vegetation Upland		**Class** Forest
Formation Type Forest and Woodland		**Subclass** Evergreen Forest
Biome Cold Temperate Forests and Woodlands		**Group** Temperate and Subpolar Needle-Leaved Evergreen Forest
Regional Formation Rocky Mountain (=Petran) Montane Conifer Forest		**Formation** Evergreen Needle-Leaved Woodland with Rounded Crowns (Upland)
Series Pine Series		
Association *Pinus ponderosa*	<	**Alliance** *Pinus ponderosa* Alliance
Pinus ponderosa/Quercus gambelii	=	**Association** *Pinus ponderosa/ Quercus gambelii*

5.7 Current Status of the National Vegetation Classification System

5.7.1 State Coverage

The data used to generate the communities in the national vegetation classification come from a wide variety of sources. The national classification is primarily based on communities described and tracked by individual state Natural Heritage programs. The combined expertise of these programs has contributed substantially to the generation of the national vegetation classification. The national classification currently covers all of the United States except Alaska and Hawaii, and work is underway to incorporate these states.

5.7.2 Regional Coverage

The information on most vegetation types identified in the state Natural Heritage program classifications has been synthesized to describe national elements. In addition, some elements have been derived from rigorous analysis at the regional level. The western, midwestern, eastern, and southeastern regions have now completed provisional regional classifications (Allard 1990, Bourgeron and Engleking 1993, Bourgeron and Engleking 1994, Faber-Langendoen 1993, Sneddon and Metzler 1992, Sneddon *et al*. 1994). The majority of the floristic units in these classifications are based on qualitative assessment of available data. Approximately 20 percent of the elements are the result of quantitative analysis (see Table 7). Each regional classification is now organized under the national vegetation classification hierarchy. There remains some redundancy in the Alliances and community elements listed in the regional classifications, as the evaluation of communities that occur in more than one region has not been fully completed.

The regions vary in the degree of refinement and the total number of community elements identified (Table 7). The variation among regions in the number of floristic units is due to differences in the amount of available community information, the diversity of habitats, and the overall geographic coverage among regions. The differences also reflect the classification approach adopted by the regions to develop their units and the levels of financial support for classification work. For example, the eastern region has recently been supported by the USGS Gap Analysis program to generate a list of all Alliances in the region. A comprehensive list of Alliances (126) was completed as a result of this project, though the list of community elements is not complete for this region. This region expects to have classified approximately 400 community elements upon completion. In contrast, the western region has worked primarily from the bottom up and has identified alliances by grouping known plant associations.

Table 7. Number of Floristic Units Identified in each Region

	East	Midwest	Southeast	West
Alliances	126	203	367	520
Communities	70	471	230	2,010

5.7.3 National Coverage

The number of units currently identified for each level of the classification hierarchy is presented in Table 8. The physiognomic levels of the hierarchy are still being tested and refined. Significant structural modification of the physiognomic levels of the hierarchy is not expected. The addition of several new formations is pending review by the group of national and regional ecologists which comprise the "national ecology team." The greatest fluctuation in the number of units identified under each level of the hierarchy is expected to be in the floristic levels. It is estimated that perhaps as many as 1,500 additional community elements may be identified as the classification is refined.

Table 8. Number of Units Currently Identified for Each Level of the Classification Hierarchy

Class	9
Subclass	33
Formation Group	103
Formation	254
Alliances*	1,216
Community Element*	2,781

*The numbers of Alliances and community elements represent a simple total of the units identified in each regional classification. As a result, communities that occur in more than one region may be counted more than once. All of the regional floristic units that are suspected to cross regional boundaries are currently being evaluated to create a more consistent national list of vegetated terrestrial communities.

Up to this time, the approach to refine the national vegetation classification system has been prioritized to those types that have been identified as rare at the state level and then proceed to the more common types. As part of a project supported by the United States Fish and Wildlife Service, an initial survey of the rare communities of the conterminous United States has been completed (Grossman *et al*. 1994). Each of the 371 rare communities identified in the report has been placed into the national hierarchy and duplication among regions rectified. Descriptions have been written for each type and confidence levels assigned.

5.7.4 Gaps in the Classification

5.7.4.1 Gaps in State-Level Information

The degree of community information varies considerably among states. Some states lack classifications for their communities altogether, while others have classifications that are at a coarser level than the national vegetation classification standard. Others may have classifications but inventory efforts for communities have not been extensive. As a result, the national vegetation classification contains more information in some states than others. In the eastern region, additional information is needed from Maryland, Rhode Island, Virginia, and West Virginia to fill gaps in the national vegetation classification. Additional information is needed from Alabama, Georgia, and Texas to refine the southeastern portion of the national vegetation classification. In the midwestern region, the states of Iowa, North Dakota, and South Dakota require additional inventory and classification work to refine the national vegetation classification. Although additional community information from the states listed above is needed to refine the national vegetation classification, efforts have been made to supplement the information from the state Natural Heritage programs with information from other sources available for communities in these states. The National Park Service vegetation mapping project will allow additional information to be collected in many of these states. Many of the vegetation units identified in parks in these states will be treated as new types and will be fit into the national vegetation classification using the process for adding new classes described above.

5.7.4.2 Types Still in Need of Basic Work

Although the classification includes vegetation from all of the physiognomic classes (forests, woodlands, shrublands, etc.), there is a greater amount of information available for some vegetation classes than others. In general, more is known about the forest, woodland, and shrubland classes than about herbaceous and sparse woody classes (sparse woodland, sparse shrubland, sparse dwarf shrubland). Comparatively little is known about the sparsely vegetated communities. In addition, the degree of confidence associated with upland types in the classification is generally higher than for wetland types. The classifications for communities that occur as complexes or in zones are also in need of further work.

6.0 Vegetation Mapping

6.1 Theoretical Background

A vegetation map is a special application of a vegetation classification (Kuchler 1988). Vegetation classification defines units based on the similarity of structural, floristic, and ecological characteristics of the vegetation. The classification units are used to label homogeneous patches of vegetation to make a vegetation map. A vegetation classification is usually developed first, then the spatial relationships of the vegetation units are described in a map. Modifications to the classification system often occur as the mapping proceeds. These map units, or polygons, represent various levels of organization of vegetation information. The map products will differ with the classification system that is used to label the vegetation.

Vegetation mapping requires a combination of knowledge and experience in several disciplines. The investigator(s) must have considerable ecological knowledge of the area to be mapped including the ability to identify individual plant species, vegetation types, and the relationships of these types to other factors, such as topography, soil types, and moisture gradients, within the mapping area. It also requires that the investigator(s) have experience with general cartographic and aerial photo-interpretation techniques. This is particularly important for the ecological interpretation of remote sensing data and digital image processing and map preparation. Most importantly, the investigator(s) must clearly understand the relationships between these disciplines during the mapping process.

6.1.1 Vegetation Mapping Standards

Map scale is the extent of reduction required to display a portion of the earth's surface on a map and is defined as a ratio of distances between corresponding points on the map and on the ground (Robinson *et al*. 1978). Scale indirectly determines the information content and size of the area being represented. The mapping scale is determined by the project objectives and the characteristics of the data obtained for the project area.

Vegetation maps display every vegetation class that occurs in the mapping area if the largest map unit equals or exceeds the predetermined minimum mapping unit (MMU). Every polygon is usually labeled using one vegetation class of the classification system any other attributes of interest (e.g., height class, degree of disturbance). Additional mapping conventions can be developed to display particular classes that are smaller than the MMU and to map polygons that depict complexes of vegetation types.

6.1.2 Imagery Analysis and Vegetation Mapping

The actual process of vegetation mapping requires the identification and delineation of homogeneous vegetation types on aerial photographs or satellite images, and portraying this information on a map using standard cartographic methods. Several decisions must be made prior to mapping, such as the level of hierarchy of a given classification system that will be mapped, the level of accuracy, and minimum area and width standards. Once identified, the polygons are labeled with the vegetation units identified in the classification. If a map polygon does not fit the listed vegetation classes, the classification must be modified, the additional information included as a data attribute, or the map redrawn to reflect the new information. Through this process, accurate vegetation maps can be generated while the classification system is tested and refined.

6.1.2.1 Diagnostic Characteristics of the Signatures

Characteristics of different vegetation types (e.g., physical characteristics of individual species, the abundance and distribution of species) can create visual differences on aerial photos. The major diagnostic features the interpreter uses to recognize these characteristics of particular vegetation types are photographic texture (smoothness or coarseness of images), tonal contrast or color, pattern, association, relative sizes of crown images, and topographic location or site (Avery 1977, Lillesand and Kiefer 1987). When observed singly, most of these features of the photo may not have strong diagnostic value. Taken together, they make up a diagnostic "signature" which is an effective tool in identifying vegetation patterns from the photos and allows vegetation to be mapped without having to visit every vegetation polygon on the ground. When delineating boundaries around polygons with apparently different signatures, the photo interpreter looks for repetitions of signature types, signatures that are commonly found together, and associations of signatures with other features on the photo such as a river's edge or a mountain slope.

The photo-interpretation process is facilitated if the interpreter has a thorough understanding of the vegetation of the area to be mapped. With knowledge of the classification for the area, the interpreter can begin to create keys that link the signatures identified on the photographs to the actual vegetation types on the ground and those listed in the classification. For example, on color infrared photos, pocosins (a deciduous saturated shrubland community element found in North Carolina and possibly South Carolina — scientific name: Zenobia pulverulenta-Chamaedaphne calyculata Shrubland) have signatures that appear as fine, even -textured, dark-colored ovals with relatively distinct light-colored boundaries. The signatures also include regularly scattered "pock marks." In this case, the fine, even texture indicates that the vegetation is shrub dominated. The oval shape and distinct light-colored boundary indicates that the vegetation occurs in Carolina Bays (a geomorphic feature) which have sandy rims. The scattered pock marks indicate the emergent pond pines (Pinus serotina), which is one of the diagnostic species for this community element. The combined clues from signature and knowledge of the biological composition of the community help the interpreter make the correct attribution of the community on the photo.

6.1.2.2 Challenges of Using Imagery Analysis for Vegetation Mapping

The concepts related to the "continuum vs. community unit" debate are magnified when applying a vegetation classification to a map. Delineation of vegetation boundaries on maps or photos requires drawing sharp boundaries between different vegetation types. In nature, such sharp boundaries are the exception rather than the rule. On the ground, vegetation types tend to blend gradually into one another, often in response to the environmental gradients. Steep environmental gradients tend to produce distinct vegetation boundaries where gradual environmental gradients tend to produce wider transition zones between vegetation types. Vegetation mappers must identify discrete boundaries and assign vegetation classes to each even though vegetation units on the ground may grade gradually one into another. As a result, the photo-interpretation process imposes a certain amount of error regardless of how the vegetation map is made.

Vegetation mapping is also limited by the imagery interpretation and other tools available for identifying vegetation polygons on the landscape. The degree to which vegetation types can be recognized may depend on the quality, scale, and season of photography, as well as the type of film used. As a result, the relationship between the units identified in the vegetation classification and the polygons identified on the map is not always one-to-one. Sometimes the vegetation characters that define a particular unit in the vegetation classification cannot be identified on the imagery. Imagery only shows what can be seen from above the vegetation canopy, so it can be difficult to discern the understory species that may be the diagnostic species for a particular community element. This is especially true in delineating forest types with a closed canopy. For example, a photo interpreter may be able to identify several white pine-dominated forests on imagery, but may not be able to discern that the stands have very different understory species compositions. In other words, they can identify an alliance clearly on the imagery, but cannot confidently assign it a community element name.

This classification problem can be rectified by (1) visiting the polygon on the ground and collecting the necessary information to assign the correct community element name to polygon, or (2) predicting the community element based on the correlation between the understory composition and key geographic or environmental variables (if known). In addition, some communities on the ground may be smaller than can be mapped at a given scale causing the photo interpreter to make a decision to label the polygon either (1) as a complex of more than one community in the classification or (2) according to the class that covers the most area in the polygon.

Vegetation mapping on aerial photographs requires a certain amount of subjective judgment. Therefore, experience of the photo interpreter in the general vegetation is an important factor in producing an accurate map. In addition, it is impossible to field check every square foot on the ground, necessitating the use of some type of sampling system which will always have a certain (measurable) amount of inherent error. Most of the difficulties of using imagery analysis to map vegetation are not insurmountable. Though these limitations do introduce error into the mapping process, consistent decision rules can be developed so the errors are minimized and explicit.

6.2 Mapping the National Vegetation Classification System

The national vegetation classification system will be used to attribute the vegetation polygons on all of the maps produced for the NPS/USGS mapping project. Based on the objectives of this project, the map scale of 1:24,000 was selected to portray the appropriate level of classification and mapping required for the inventory and monitoring objectives. The smallest vegetation polygons, or minimum mapping unit, on the final maps will be 0.5 hectares. All existing vegetation types within the mapping area will be mapped. The vegetation maps will represent every vegetation class that occurs throughout the mapping area if individual polygons are greater than minimum mapping unit. As a rule, every polygon will be attributed using one vegetation class of the classification system (see Section 6.2.2.2 for a discussion of mapping complexes of communities). The per-class accuracy of the maps must exceed 80 percent.

6.2.1 Decision to Map the Alliance versus the Community Element

Ideally, all polygons of the vegetation maps will be labeled at the community element level and will meet the 80 percent class accuracy requirement. However, due to the complexity of field conditions and inherent limitations of aerial photography, it may be technically infeasible and economically inappropriate to map vegetation polygons at the community element level. Since the Alliance level is generally determined by the overstory dominant and diagnostic species, this level lends itself quite well to being identified on aerial photographs. As stated above, it is often difficult to see the diagnostic species that are required to classify to the community element on imagery. There are, however, several ways to map to the community elements if the Alliance is known.

It is estimated that more than half of all the community elements within a given Alliance in the national vegetation classification are well separated geographically. Therefore, if the Alliance is known as well as geographic location, the community element can be predicted with certainty. For example, if you are standing in a Pitch Pine–scrub oak barren Alliance (scientific name: Pinus rigida/Quercus ilicifolia Woodland Alliance) in Pennsylvania, it will most likely be the Pitch Pine/Scrub Oak/Black Chokeberry community element (scientific name: Pinus rigida/Quercus ilicifolia/Aronia melancarpa Woodland). But if you are on eastern Long Island, it will definitely be the Pitch Pine/Scrub Oak/Bayberry Woodland community element (scientific name: Pinus rigida/Quercus ilicifolia/Myrica pennsylvanica).

Some community elements cannot be confidently predicted on the basis of the Alliance and location alone. This is a more common occurrence in the northwestern and southeastern forest communities. In these cases, a single alliance may have continuous cover on a site but the understory composition shifts so that more than one community element can occur. In other words, what appears as a homogeneous vegetation unit on the aerial photograph can be classified as one alliance but may actually represent more than one community element. When this occurs, the community elements can often be predicted based on their correlation to major environmental gradients. For example, within the Douglas Fir Forest Alliance (scientific name: Pseudotsuga menziesii Forest Alliance) the Douglas Fir/Sword Fern Forest community element (scientific name: Pseudotsuga menziesii/Polystichum munitum Forest) is generally found on low moist sites, whereas the Douglas Fir/Salal Forest community element (scientific name: Pseudotsuga menziesii/Gaultheria shalon Forest) is generally found on dry sites.

For a relatively small number of communities, it may not be possible to predict the community element based on knowledge of the alliance, geographic location, or key environmental factors. The only way these community elements of the classification can confidently be assigned to the map units is by visiting them on the ground and collecting enough field information to assign the correct community element name.

Most of these conditions will likely be encountered when mapping the vegetation of a particular park. It will usually be possible to map the community element directly from photography or to accurately predict the community element from environmental and geographic information. If the community element cannot be identified or predicted, there are three choices that can be made: (1) The type can be mapped to community element level accepting a lower degree of accuracy, (2) The type can be mapped to the community element level and the necessary field data will be collected to meet the minimum class accuracy requirements, (3) The type can be mapped to the Alliance level. These decisions will be made on a park-by-park basis and will largely be determined by the ecological importance of the communities and the level of available funding.

When it is necessary to map a type at the Alliance level, it does not infer that all of the vegetation on that park should similarly be mapped at that level. The vegetation should be mapped at the finest level possible, and accuracy would then be assessed at the level that the polygon is attributed.

6.2.2 Extension of the Proposed National Vegetation Classification System for Application to Vegetation Maps

6.2.2.1 Mapping Different Expressions of the Floristic Units

The vegetation maps must delineate vegetation units that will help the park managers meet their resource planning, management, inventory, and monitoring objectives. At the same time, the vegetation classification must support the capability to assess regional and national issues.

To support regional and national assessments of vegetation resources, it is essential that the polygons on all of the vegetation maps be attributed to the Alliance or community element level classification (see Section 6.2.1 for a discussion of this issue). However, the same community element (or Alliance) may often have multiple physical "expressions" on the ground based on past disturbance history, pest infestations, old growth characteristics, etcetera, and these expressions are often of great importance to park managers. For example, Dry Rich Forests (scientific name: Carya sp.- Fraxinus americana-Quercus sp. Forest) in the northeastern United States are becoming increasingly infested with gypsy moths. In a given area, some occurrences of these vegetation types are more severe than others. Because gypsy moths typically strip the leaves from the deciduous trees, variation in the level of infestation is often clearly discernable on the ground and on aerial photos. These different expressions of infestation do not change the classification of the community element, they are simply more detailed characteristics of the occurrences of the Dry Rich Forest types.

In addition to being attributed with the Alliance or community element name, polygons on the maps can be attributed with these different expressions. As with the floristic units, these additional expressions of the vegetation should be discernable on imagery or easily predicted based on correlations to key environmental variables. Each polygon will be labeled with the name of the community element (or alliance) as well as with a measure of the expression.

There are some expressions such as height classes and measures of vigor (e.g., disease and pest infestations, amount of standing dead wood) that will be of interest to a large number of park managers. A list of these additional attributes of the floristic units is being developed so that these attributes can be applied in a standardized fashion for this mapping project. During the pilot phase of this project, the specific values of each of these expressions will be determined.

For example, if insect infestation is chosen as a standard attribute to be mapped, then the values (or classes) might include uninfested, low infestation, moderate infestation, high infestation, and/or decimated. Guidelines for assigning polygons to these classes will be produced.

Other vegetation expressions are only of interest at the level of the individual park. These will be identified and mapped on a park-by-park basis depending on the interest of the park manager and available funding.

6.2.2.2 Collecting and Tracking Additional Attribute Data on a Park-by-Park basis

To meet the objectives of different parks, additional data on attributes other than those identified above will frequently be needed to characterize the vegetation and their polygons across the landscape. Many of these attributes may not need to be identified as formal expressions of the type, but the information may need to be tracked for resource management purposes. For example, it may be of critical resource management importance to note the percent dead and down wood in old growth stands, though there may be no need to recognize different classes of old growth stands based on the amount of dead and down wood. As with the expressions identified above, the classes of down/dead wood will not change the classification unit. However, they provide critical information in the characterization of the vegetation type and the analysis of the data to build wildlife habitat and fire loading models.

During the planning phase of the project for each park, these important additional attributes will be identified. Additional field data on these attributes can be collected and the polygons can be attributed with these data in the appropriate records of the relational database management systems.

6.2.3 Nonhomogeneous Mapping Units

6.2.3.1 Landscapes with Communities Less Than the Minimum Mapping Unit

Occurrences of vegetation types that are smaller than the minimum mapping unit will generally be merged with neighboring occurrences and the polygon will be named by the dominant class (by area). As a example, in Everglades National Park, mahogany hammock communities less than 0.5 hectares can occur in a matrix of the sawgrass slough community. On the vegetation maps, the polygons will be lumped and labeled as sawgrass community elements. If these features that are less than the minimum mapping unit are of significant ecological or management importance, they will generally be mapped as separate points within the landscape matrix and tracked separately in the spatial database. Otherwise, the attributes of the larger polygon will document the relative coverage of the different vegetation communities.

6.2.3.2 Community Complexes

Some plant associations occur with other plant associations in a heterogeneous pattern and the components are uniquely tied together ecologically. These occurrences are called community complexes. Though these complexes have, as components, more than one plant association, they are considered as a single element in the classification and mapped as such. For example, wooded dune and swale communities have different compositions but occur together in a complex pattern and are tracked a single element in the classification and mapped as a single unit (Comer and Albert 1993).

6.2.3.3 Map Units Containing More Than One Community Element

In some cases, more than one distinct community element can occur together in repeating patches which are each smaller than the minimum mapping unit. In these cases, the components are recognized as different community elements, but since the patches of each component are less than the minimum mapping unit, they are recognized as a single mapping unit composed of both community elements.

6.2.3.4 Transition Zones Greater Than the Minimum Mapping Unit

In areas where the transition zone between two vegetation types is greater than the minimum mapping unit and the vegetation does not meet the requirements for being classified as a new community (i.e., it does not have a significantly different biotic composition, is not associated with different environmental conditions, or is not documented to recur across the landscape), the zone will be mapped as a transition zone between the neighboring types. It will be labeled with the names of both communities and given a designation as transition zone.

6.3 Examples of Vegetation Mapping Projects

The Nature Conservancy has implemented multiple projects that have applied the physiognomic–floristic vegetation classification system to produce vegetation maps as a component of the conservation planning methods. Though the general objectives have been consistent, the applications have varied in terms of scale, resources, information base, and desired end products to meet the specific objectives. Different types of remote sensing data and supplementary thematic data are applied to meet the different needs of these projects.

6.3.1 John Crow and Blue Mountains of Jamaica

In an effort to help develop conservation strategies for the country of Jamaica, The Nature Conservancy performed a Rapid Ecological Assessment (REA) of the Blue and John Crow Mountains National Park (Muchoney *et al*. 1993). The REA process consists of a series of increasingly detailed analyses, with each step identifying those sites of greatest conservation interest and concentrating further analysis on high-priority sites. REA has been developed in response to the need for rapid information collection and analysis in areas that are either biologically not well known or are exceptionally diverse at a habitat or species level.

The goal of this REA was to complete a detailed, mapped inventory of the important biological information needed to assist conservation planning and management activities in and around the Blue and John Crow Mountains National Park. This information included a land cover map that portrayed a classification of natural and modified ecological communities, a list of rare and endemic species, environmental data, and landscape and topographic information.

The REA for the John Crow and Blue Mountains was completed through aerial photo interpretation and computer-assisted analysis of multispectral Landsat Thematic Mapper (TM) and SPOT panchromatic imagery and digital environmental data. Computer classification of the TM data was used to identify potential natural community classes as well as land cover classes in and around the park. Aerial photography was acquired to provide high-resolution current spatial information. Additional environmental data including digital terrain, geology, hydrology, transportation infrastructure, and soils were used to stratify for field sampling, enhance the ecological classification, and meet the information requirements for park design and management. Within the park, survey sites were determined based on the analysis of the imagery, soils, geology, and elevation data. Field surveys were conducted to verify the classification and to acquire community data for characterization of ecological communities and to provide detailed biological data. The products of this effort included a refined vegetation classification, a land cover map, maps of the other environmental factors, and digital databases.

6.3.2 Altamaha River Bioreserve, Georgia

The Nature Conservancy conducted an ecological inventory of the Altamaha River Bioreserve in Georgia to support conservation planning and management of this ecosystem scale protection project (The Nature Conservancy 1994). The inventory included the production of a land cover map of the area which spanned 15 USGS quad maps (approximately 900 square miles). The land cover map was created using Landsat Thematic Mapper satellite imagery, SPOT

Panchromatic Quad maps, and USDA National Aerial Photography Program (NAPP) photographs and extensive field inventory, which included plot sampling. More than 12,000 polygons representing ecological community boundaries were classified using 161 land cover classes. Land cover classes were based on The Nature Conservancy's Southeastern Natural Community Classification (Allard 1990).

7.0 Addressing USGS/NPS Objectives

Additional specifications to be met for successful project implementation will come from the individual national parks, the National Park Service, and the U.S. Geological Survey. The classification system must also meet standards put forth by the Federal Geographic Data Committee and must adhere to high standards generally accepted by the scientific community.

7.1 Management Objectives

Specific issues will arise as a result of the unique characteristics and management concerns of each individual park. The proposed classification system and inventory methodology offers great flexibility in that it provides land managers with basic comparable units upon which to focus management practices, regardless of the variability in management schemes or objectives. Sensitivity to the specific concerns of individual park managers, and the flexibility to expand or refine the system as appropriate will be observed in all facets of the project to ensure the practical utility of the data products.

7.2 Inventory and Monitoring Objectives

The NPS/USGS Vegetation Mapping project has been initiated in response to the need for background data across all park units to meet resource management needs and deal with existing and potential resource threats and issues. These needs have been articulated through the NPS Service-wide Inventory and Monitoring (I&M) Program. The NPS goals and objectives for I&M will be reviewed on a regular basis to ensure that this project supports as many of these objectives as possible.

7.3 Systemwide Requirements

The ability to complete national assessments of the community types and their health and condition, and to make consistent national plans across an agency requires the application of consistent national standards. The systemwide objectives will be continuously evaluated in light of the inventory and classification methodology to ensure the highest practical level of products from this project.

7.4 Information Transfer and Exchange

The need to address objectives from multiple levels within an agency and to work across agencies necessitates the development of clear standards for information capture and management throughout this project. The information that will be developed will conform to high levels of standardization. The format for the information and the information management systems will play a pivotal role in determining the speed and efficiency of applying as well as sharing the information through data transfer and exchange protocols.

8.0 Conclusion

A goal of the NPS/USGS vegetation mapping project is to provide national leadership in the establishment of protocols that will create a better understanding of the vegetative resources of our nation. Numerous specifications are required for a national vegetation classification standard that will provide this understanding. The proposed classification system is being developed to meet these requirements. It is based on a *sound scientific approach* that is a logical development from past studies. It *follows directly from historical standards* set forth by UNESCO and the European phytosociological tradition. As such, it is *well documented* and *broadly accepted both nationally and internationally* as a standard to classify *existing vegetation types* that repeat across the landscape.

The proposed national vegetation classification system is *hierarchically organized* such that it can be *applied at multiple scales*. It is based on homogenous units that *are discernable on the ground and from imagery* and thus *can be mapped*. The system is supported by a *replicable approach* that is based on *standard field and data analysis methods*. The system is *flexible* and *open ended* such that it will *allow for additions, modifications, and continuous refinement*.

Finally, the proposed classification system identifies and characterizes classification units that are appropriately scaled to *meet objectives for park planning and ecosystem management*, as well as the national and regional objectives of the NPS/USGS Vegetation Mapping Project.

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11.0 Appendices

11.1 List of Documented Alliances Organized Under the Heirarchy – August, 1984

In the classification hierarchy, each unit is distinguished by a unique code. The components of the code represent each level in the hierarchy. Alliances are not currently coded but are listed under the appropriate formation by region of occurrence. A "*" indicates formations which have not officially been incorporated into the hierarchy, but are under review for future inclusion. All formations in the hierarchy are listed whether or not alliances have been identified.

I, II, etc. = **PHYSIOGNOMIC CLASS**
A, B, etc. = *PHYSIOGNOMIC SUBCLASS*
1, 2, etc. = FORMATION GROUP
a,b, etc. = Formation
REGION
Alliances

I. **FOREST**
I.A. *EVERGREEN FOREST*
I.A.1. TROPICAL RAIN FOREST (mainly broad-leaved evergreen trees, neither cold-nor drought-resistant)
I.A.1.a Tropical lowland rain forest
I.A.1.b Tropical submontane rain forest
I.A.1.c Tropical montane rain forest
I.A.1.d Tropical "subalpine" rain forest
I.A.1.e Tropical cloud forest
I.A.1.f Tropical seasonally flooded rain forest
I.A.1.g Tropical semipermanently flooded rain forest
I.A.1.h Tropical evergreen saturated forest
I.A.1.i Tropical brackish semipermanently flooded rain forest

I.A.2 TROPICAL AND SUBTROPICAL SEASONAL EVERGREEN FOREST (mainly broad-leaved evergreen trees with some foliage reduction in dry season)
I.A.2.a Tropical or subtropical seasonal lowland evergreen forest

SOUTHEAST
Casuarina (*equisetifolia, cunninghamiana, glauca*) Forest Alliance

Metopium toxiferum-Eugenia foetida Forest Alliance
Pithecellobium ebano Forest Alliance
Sabal palmetto Upland Forest Alliance

I.A.2.b Tropical or subtropical seasonal submontane evergreen forest
I.A.2.c Tropical or subtropical seasonal montane evergreen forest
I.A.2.d Tropical or subtropical dry "subalpine" evergreen forest
I.A.2.e Tropical or subtropical seasonal evergreen semipermanently flooded forest

SOUTHEAST
Casuarina (*cunninghamiana, glauca*) Wetland Forest Alliance
Magnolia virginiana-Chrysobalanus icaco Subtropical Forest Alliance
Melaleuca quinquenervia Forest Alliance
Schinus terebinthifolius Wetland Forest Alliance

I.A.2.*. Tropical or subtropical seasonal evergreen seasonally/temporarily flooded forest

SOUTHEAST
Sabal mexicana Wetland Forest Alliance

I.A.3 SUBTROPICAL RAIN FOREST
I.A.3.a Subtropical lowland rain forest
I.A.3.b Subtropical submontane rain forest
I.A.3.c Subtropical montane rain forest
I.A.3.d Subtropical "subalpine" rain forest
I.A.3.e Subtropical cloud forest
I.A.3.f Subtropical seasonally flooded rain forest
I.A.3.g Subtropical semipermanently flooded rain forest
I.A.3.h Subtropical evergreen saturated rain forest

I.A.4 MANGROVE FOREST
I.A.4.a Tropical or subtropical saltwater-tidal semipermanently flooded forest (e.g. mangroves of Florida)

SOUTHEAST
Avicennia germinans Forest Alliance
Rhizophora mangle Forest Alliance
Laguncularia racemosa Forest Alliance

I.A.5 TEMPERATE AND SUBPOLAR EVERGREEN RAIN FOREST (restricted to southern hemisphere)

I.A.5.a Temperate evergreen rain forest
I.A.5.b Temperate evergreen seasonally flooded rain forest
I.A.5.c Temperate evergreen semipermanently flooded rain forest
I.A.5.d Subpolar evergreen rain forest

I.A.6 TEMPERATE SEASONAL EVERGREEN FOREST (mainly broad-leaved evergreen or mixed broad-leaved/needle-leaved forest with some foliage reduction in the dry season)
I.A.6.a Temperate seasonal lowland evergreen forest

SOUTHEAST
Quercus virginiana Upland Forest Alliance
Quercus virginiana-Sabal palmetto Upland Forest Alliance

WEST
Washingtonia filifera Forest Alliance

I.A.6.b Temperate seasonal submontane evergreen forest
I.A.6.c Temperate seasonal montane evergreen forest
I.A.6.d Temperate dry "subalpine" evergreen forest
I.A.6.e Temperate seasonal evergreen (wetland) forest

SOUTHEAST
Gordonia lasianthus Forest Alliance
Gordonia lasianthus-Pinus serotina Forest Alliance
Persea palustris Forest Alliance
Quercus virginiana Wetland Forest Alliance
Sabal palmetto-Quercus virginiana Wetland Forest Alliance

I.A.7 WINTER-RAIN, EVERGREEN BROAD-LEAVED SCLEROPHYLLOUS FOREST (stiff, leathery-leaved trees)
I.A.7.a Winter rain lowland and submontane evergreen sclerophyllous forest over 50 m tall (e.g. Eucalyptus in California)
I.A.7.b Winter rain lowland and submontane evergreen sclreophyllous forest under 50 m tall (e.g., Live oak in California)

I.A.8 TROPICAL AND SUBTROPICAL NEEDLE-LEAVED EVERGREEN FOREST
I.A.8.a Tropical and subtropical lowland and submontane needle-leaved evergreen forest
I.A.8.b Tropical and subtropical montane and subalpine needle-leaved evergreen forest

I.A.9 TEMPERATE AND SUBPOLAR NEEDLE-LEAVED EVERGREEN FOREST (mostly needle-leaved and scale-leaved trees)

I.A.9.a Needle-leaved evergreen giant forest (e.g., redwood and Douglas fir)

WEST

Abies amabilis Giant Forest Alliance
Abies concolor Giant Forest Alliance
Abies concolor-Abies magnifica Giant Forest Alliance
Abies grandis Giant Forest Alliance
Chamaecyparis lawsoniana Giant Forest Alliance
Picea breweriana Giant Forest Alliance
Picea sitchensis Giant Forest Alliance
Pinus ponderosa Giant Forest Alliance
Pseudotsuga menziesii Giant Forest Alliance
Pseudotsuga menziesii/*Lithocarpus densiflorus* Giant Forest Alliance
Pseudotsuga menziesii-Sequoia sempervirens Giant Forest Alliance
Pseudotsuga menziesii-Tsuga heterophylla Giant Forest Alliance
Thuja plicata Giant Forest Alliance
Tsuga heterophylla Giant Forest Alliance
Tsuga mertensiana Giant Forest Alliance

I.A.9.b Needle-leaved evergreen forest with rounded crowns (e.g., pines, western juniper)

EAST

Tsuga canadensis-Pinus strobus Forest Alliance*
Pinus strobus-Pinus resinosa Forest Alliance

SOUTHEAST

Pinus clausa Forest Alliance
Pinus echinata Forest Alliance
Pinus echinata-Pinus rigida Forest Alliance
Pinus echinata-Pinus rigida-Pinus virginiana Forest Alliance
Pinus echinata-Pinus virginiana Forest Alliance
Pinus echinata-Pinus taeda-Pinus virginiana Forest Alliance
Pinus elliottii Upland Forest Alliance
Pinus elliottii-Pinus taeda Upland Forest Alliance
Pinus glabra Upland Forest Alliance
Pinus palustris Upland Forest Alliance
Pinus palustris-Pinus echinata Forest Alliance

Pinus palustris-Pinus elliottii Upland Forest Alliance
Pinus palustris-Pinus taeda Forest Alliance
Pinus palustris-Pinus taeda-Pinus echinata Forest Alliance
Pinus ponderosa Forest Alliance
Pinus ponderosa-Pseudotsuga menziesii Forest Alliance
Pinus pungens Forest Alliance
Pinus pungens-Pinus (*rigida, virginiana*) Forest Alliance
Pinus resinosa Forest Alliance
Pinus rigida Upland Forest Alliance
Pinus rigida-Pinus virginiana Forest Alliance
Pinus rigida-Tsuga caroliniana Forest Alliance
Pinus strobus Forest Alliance
Pinus strobus-Pinus echinata Forest Alliance
Pinus strobus-Pinus virginiana Forest Alliance
Pinus strobus-Tsuga canadensis Forest Alliance
Pinus taeda Upland Forest Alliance
Pinus taeda-Pinus echinata-(*Juniperus virginiana*) Forest Alliance
Pinus taeda-Pinus virginiana Forest Alliance
Pinus virginiana Forest Alliance

MIDWEST
Pinus banksiana Forest Alliance
Pinus contorta Forest Alliance
Pinus echinata Forest Alliance
Pinus ponderosa Forest Alliance
Pinus strobus-(*P. resinosa*) Forest Alliance
Pinus virginiana Forest Alliance

WEST
Pinus albicaulis Forest Alliance
Pinus contorta Forest Alliance
Pinus monticola Forest Alliance
Pinus ponderosa Forest Alliance
Pinus ponderosa-Pseudotsuga menziesii Forest Alliance

I.A.9.c Needle-leaved evergreen forest with conical crowns (e.g., spruce, eastern juniper, cedar)

EAST
Juniperus virginiana Forest Alliance*

Picea rubens-Abies (*balsamea, fraseri*) Forest Alliance*
Picea mariana Forest Alliance*
Thuja occidentalis Forest Alliance

<u>SOUTHEAST</u>
Abies fraseri Forest Alliance
Juniperus ashei Forest Alliance
Juniperus virginiana var. *virginiana* Forest Alliance
Picea abies Forest Alliance
Picea rubens Upland Forest Alliance
Picea rubens-Abies fraseri Forest Alliance
Picea rubens-Tsuga canadensis Forest Alliance
Tsuga canadensis Upland Forest Alliance
Tsuga caroliniana-(*Tsuga canadensis*) Forest Alliance

<u>MIDWEST</u>
Juniperus ashei Forest Alliance
Juniperus virginiana Forest Alliance
Picea glauca Forest Alliance
Picea glauca-abies balsamea Forest Alliance
Picea mariana Forest Alliance
Thuja occidentalis Forest Alliance

<u>WEST</u>
Abies amabilis Forest Alliance
Abies concolor Forest Alliance
Abies grandis Forest Alliance
Abies lasiocarpa Forest Alliance
Abies magnifica Forest Alliance
Chamaecyparis nootkatensis Forest Alliance
Cupressus arizonica Forest Alliance
Picea engelmannii Forest Alliance
Picea glauca Forest Alliance
Picea pungens Forest Alliance
Picea sitchensis Forest Alliance
Picea spp. Forest Alliance
Pseudotsuga menziesii Forest Alliance
Thuja plicata Forest Alliance
Tsuga heterophylla Forest Alliance
Tsuga mertensiana Forest Alliance

I.A.9.d Needle-leaved evergreen forest with cylindrical crowns (boreal) (e.g., spruce forests of Alaska)

I.A.9.e Needle-leaved evergreen seasonally flooded/saturated forest with rounded crowns

<u>MIDWEST</u>
Picea glauca Wetland Forest Alliance
Pinus banksiana Wetland Forest Alliance
Pinus strobus Wetland Forest Alliance
Tsuga canadensis Wetland Forest Alliance

<u>WEST</u>
Pinus contorta Wetland Forest Alliance

I.A.9.f Needle-leaved evergreen seasonally flooded/saturated forest with conical crowns

<u>EAST</u>
Tsuga canadensis Wetland Forest Alliance
Picea rubens-Abies balsamea Wetland Forest Alliance
Picea mariana Wetland Forest Alliance
Thuja occidentalis Wetland Forest Alliance

<u>MIDWEST</u>
Picea mariana Wetland Forest Alliance
Thuja occidentalis Wetland Forest Alliance

<u>WEST</u>
Abies amabilis Wetland Forest Alliance
Thuja plicata Wetland Forest Alliance
Tsuga heterophylla Wetland Forest Alliance
Tsuga mertensiana Wetland Forest Alliance

I.A.9.g Needle-leaved evergreen seasonally flooded/saturated forest with cylindrical crowns

I.A.9.* Needle-leaved evergreen seasonally/temporarily flooded forest with rounded crowns

<u>SOUTHEAST</u>
Pinus echinata Wetland Forest Alliance

Pinus elliottii Wetland Forest Alliance
Pinus elliottii-Pinus palustris Wetland Forest Alliance
Pinus elliottii-Pinus serotina Forest Alliance
Pinus glabra Wetland Forest Alliance
Pinus palustris Wetland Forest Alliance
Pinus palustris-Pinus taeda Wetland Forest Alliance
Pinus serotina-Pinus taeda Forest Alliance
Pinus strobus Wetland Forest Alliance
Pinus taeda Wetland Forest Alliance
Pinus taeda-Pinus palustris-Pinus serotina Forest Alliance

WEST
Pinus ponderosa Wetland Forest Alliance

I.A.9.* Needle-leaved evergreen saturated forest with conical crowns

SOUTHEAST
Chamaecyparis thyoides Saturated Forest Alliance
Picea rubens Wetland Forest Alliance
Picea rubens-Tsuga canadensis Wetland Forest Alliance
Thuja occidentalis Wetland Forest Alliance
Tsuga canadensis-(*Pinus strobus*) Wetland Forest Alliance

I.A.9.* Needle-leaved evergreen seasonally/temporarily flooded forest with conical crowns

SOUTHEAST
Chamaecyparis thyoides Seasonally/Temporarily Flooded Forest Alliance
Chamaecyparis thyoides-Pinus serotina Forest Alliance

WEST
Abies concolor Wetland Forest Alliance
Abies lasiocarpa Wetland Forest Alliance
Picea engelmannii Wetland Forest Alliance
Picea pungens Wetland Forest Alliance

I.A.9.* Needle-leaved evergreen seasonally flooded/saturated Giant forest

WEST
Abies amabilis Wetland Forest Alliance

Picea sitchensis Wetland Forest Alliance

I.A.10 EXTREMELY XEROMORPHIC EVERGREEN FOREST
I.A.10.a Evergreen sclerophyllous dominated forest
I.A.10.b Evergreen succulent forest (assumed evergreen)

I.B. *DECIDUOUS FOREST*
I.B.1 TROPICAL AND SUBTROPICAL DROUGHT-DECIDUOUS FOREST
I.B.1.a Lowland and submontane broadleaved drought-deciduous forest
I.B.1.b Montane and cloud drought-deciduous forest

I.B.2 COLD-DECIDUOUS FOREST
I.B.2.a Lowland and submontane broad-leaved cold-deciduous forest (e.g., broadleaf forests of midwest)

EAST
Acer saccharum-Betula allegheniensis-Fagus grandifolia Forest Alliance
Acer saccharum-Fraxinus americana-Tilia americana Forest Alliance
Tilia heterophylla-Aesculus octandra Forest Alliance
Acer saccharum-Quercus muehlenbergii Forest Alliance
Quercus rubra-Acer saccharum Forest Alliance
Carya-Fraxinus americana-Quercus Forest Alliance
(Northeastern Upland) *Quercus*/*Ericaceae* Forest Alliance
Quercus-Fagus grandifolia/*Ilex opaca* Forest Alliance
Prunus serotina-Amelanchier canadensis Forest Alliance
Populus tremuloides Forest Alliance
Prunus pensylvanica Forest Alliance

SOUTHEAST
Acer grandidentatum Forest Alliance
Acer saccharum-Fagus grandifolia-Liriodendron tulipifera-(*Aesculus flava, Magnolia fraseri*) Forest Alliance
Acer saccharum-Quercus muehlenbergii Upland Forest Alliance
Acer saccharum-Quercus rubra-Carya cordiformis Upland Forest Alliance
Acer saccharum-Quercus rubra-Quercus (*alba, montana*) Forest Alliance
Betula alleghaniensis Forest Alliance
Betula alleghaniensis-(*Tilia americana* var. *heterophylla, Aesculus flava*) Forest Alliance
Betula alleghaniensis-Fagus grandifolia-Aesculus flava-(*Acer saccharum*) Forest Alliance

Fagus grandifolia Upland Forest Alliance
Fagus grandifolia-Acer saccharum-(*Liriodendron tulipifera*) Forest Alliance
Fagus grandifolia-Quercus alba-Acer (*barbatum, leucoderme*) Upland Forest Alliance
Fagus grandifolia-Quercus alba-Liquidambar styraciflua-(*Liriodendron tulipifera*) Forest Alliance
Fagus grandifolia-Quercus alba-Liquidambar styraciflua-Magnolia grandiflora Forest Alliance
Fagus grandifolia-Quercus nigra Forest Alliance
Fagus grandifolia-Quercus rubra Forest Alliance
Juglans nigra-Liquidambar styraciflua-Liriodendron tulipifera Upland Forest Alliance
Juglans nigra-Quercus muehlenbergii Forest Alliance
Liquidambar styraciflua Forest Alliance
Liriodendron tulipifera Upland Forest Alliance
Liriodendron tulipifera-Betula lenta Forest Alliance
Prunus pensylvanica Forest Alliance
Prunus serotina-Liriodendron tulipifera-Fraxinus americana-(*Acer saccharum*) Forest Alliance
Quercus alba Forest Alliance
Quercus alba-Carya alba-(*Carya glabra*) Coastal Plain Forest Alliance
Quercus alba-Carya glabra Coastal Plain Forest Alliance
Quercus alba-Quercus (*coccinea, velutina*)-*Carya* (*alba, glabra*) Forest Alliance
Quercus alba-Quercus rubra-(*Carya ovata*) Forest Alliance
Quercus coccinea Forest Alliance
Quercus falcata-Quercus alba-(*Quercus stellata*)-*Carya* (*glabra, alba, pallida*) Forest Alliance
Quercus falcata-Quercus alba-(*Quercus stellata*)-*Carya texana* Forest Alliance
Quercus hemisphaerica-Liquidambar styraciflua Forest Alliance
Quercus hemisphaerica-Quercus margaretta Forest Alliance
Quercus laevis Forest Alliance
Quercus muehlenbergii Forest Alliance
Quercus prinus Forest Alliance
Quercus prinus-Quercus (*alba, falcata, velutina*)-*Carya* (*alba, glabra*) Forest Alliance
Quercus prinus-Quercus coccinea-(*Quercus velutina*) Forest Alliance
Quercus prinus-Quercus rubra-Carya (*alba, glabra, ovata*) Forest Alliance
Quercus prinus-Quercus rubra-Liriodendron tulipifera-(*Carya alba, glabra*)
Quercus rubra Forest Alliance

Quercus rubra var. *ambigua-Betula alleghaniensis*-(*Acer rubrum, Fagus grandifolia*) Forest Alliance
Quercus stellata-Carya carolinae-septentrionalis Forest Alliance
Quercus stellata-Quercus marilandica Forest Alliance
Robinia pseudo-acacia Forest Alliance
Tilia americana var. *caroliniana-Celtis occidentalis* Forest Alliance

MIDWEST
Acer saccharum-Betula spp.-(*Fagus grandifolia*, *Tilia americana*) Forest Alliance
Acer saccharum-Fagus grandifolia-Tilia spp.-*Aesculus octandra* Forest Alliance
Acer saccharum-Fraxinus americana-Quercus spp. Forest Alliance
Acer saccharum-Quercus rubra-Carya cordiformis Forest Alliance
Acer saccharum-Tilia americana-(*Quercus rubra*) Forest Alliance
Acer spicatum Forest Alliance?
Betula papyrifera Forest Alliance
Fagus grandifolia-Acer saccharum-(*Liriodendron tulipifera*) Forest Alliance
Fagus grandifolia-Quercus spp.-*Acer* spp. Forest Alliance
Populus tremuloides Forest Alliance
Populus tremuloides-Betula papyrifera Forest Alliance
Quercus alba Forest Alliance
Quercus alba-Q. rubra-(*Carya ovata*) Forest Alliance
Quercus alba-Q. rubra-Q. mcrocarpa Forest Alliance
Quercus falcata-Q. alba-Carya spp. (*texana*, *alba*) Forest Alliance
Quercus macrocarpa Forest Alliance
Quercus muehlenbergii-(*Q. shumardii-Fraxinus quadrangulata*) Forest Alliance
Quercus prinus-Q. coccinea-Q. velutina Forest Alliance
Quercus rubra Forest Alliance
Quercus stellata-Q. marilandica Forest Alliance
Quercus velutina-Q. alba-Carya spp. (*glabra*, *texana*) Forest Alliance
Quercus velutina-Q. ellipsoidalis Forest Alliance

WEST
Quercus macrocarpa Forest Alliance
Sapindus saponaria Forest Alliance

I.B.2.b Montane or boreal cold-deciduous forest
(e.g., broadleaf forests of the mountains)

WEST

Acer grandidentatum Forest Alliance
Acer macrophyllum Forest Alliance
Populus tremuloides Forest Alliance

I.B.2.c Subalpine or subpolar cold-deciduous forest

WEST
Larix lyallii Forest Alliance
Larix occidentalis Forest Alliance

I.B.2.d Cold-deciduous intermittently flooded forest (e.g., woody draws)

MIDWEST
Fraxinus pennsylvanica-Ulmus americana Forest Alliance

WEST
Fraxinus pennsylvanica Forest Alliance

I.B.2.e Cold-deciduous seasonally/temporarily flooded forest (e.g., alluvial bottomland hardwoods)

EAST
Quercus (*palustris, bicolor*) Wetland Forest Alliance
Acer saccharinum-(*Populus deltoides*) Wetland Forest Alliance
Platanus occidentalis-Betula nigra-Acer negundo Wetland Forest Alliance

SOUTHEAST
Acer negundo Forest Alliance
Acer negundo-Salix nigra Forest Alliance
Acer saccharinum Forest Alliance
Acer saccharum-Carya cordiformis Forest Alliance
Betula nigra-(*Platanus occidentalis*) Forest Alliance
Carpinus caroliniana Forest Alliance
Carya myristiciformis-Carya aquatica Forest Alliance
Fagus grandifolia Wetland Forest Alliance
Liquidambar styraciflua-(*Liriodendron tulipifera, Acer rubrum*) Wetland Forest Alliance
Liriodendron tulipifera Wetland Forest Alliance
Nyssa sylvatica Wetland Forest Alliance
Platanus occidentalis-(*Fraxinus pennsylvanica, Celtis laevigata, Acer*

saccharinum) Forest Alliance
Platanus occidentalis-(*Liquidambar styraciflua*,*Liriodendron tulipifera*) Forest Alliance
Populus deltoides Forest Alliance
Populus deltoides-*Salix* (*caroliniana, nigra*) Forest Alliance
Quercus laurifolia Wetland Forest Alliance
Quercus (lyrata, palustris)-*Liquidambar styraciflua* Forest Alliance
Quercus macrocarpa-*Quercus bicolor*-*Carya laciniosa* Forest Alliance
Quercus (*michauxii, pagoda, shumardii*)-*Liquidambar styraciflua* Forest Alliance
Quercus (*michauxii, pagoda, shumardii*) Forest Alliance
Quercus pagoda-*Carya* (*glabra, ovata*) Forest Alliance
Quercus palustris-(*Quercus bicolor*) Forest Alliance
Quercus phellos Forest Alliance
Quercus (*phellos, nigra, laurifolia*)-*Liquidambar styraciflua* Forest Alliance
Quercus phellos-*Quercus lyrata* Forest Alliance
Quercus stellata-(*Quercus palustris*) Forest Alliance
Salix (*nigra, caroliniana, sericea*) Forest Alliance
Taxodium distichum-*Platanus occidentalis* Forest Alliance

<u>MIDWEST</u>
Acer negundo Forest Alliance
Acer rubrum-*Fraxinus* spp.(*pennsylvanica*,*nigra*) Forest Alliance
Acer saccharinum Forest Alliance
Acer saccharum-*Carya cordiformis* Forest Alliance
Betula nigra-(*Platanus occidentalis*) Forest Alliance
Fraxinus pennsylvanica-(*Ulmus americana*)-*Celtis* spp. (*occidentalis*,*laevigata*) Forest Alliance
Liquidambar styraciflua-*Quercus* spp. (*lyrata, palustris*) Forest Alliance
Liquidambar styraciflua-*Quercus* spp. (*michauxii*,*pagoda*,*shumardii*) Forest Alliance
Populus deltoides Forest Alliance
Populus deltoides-*Salix nigra* Forest Alliance
Quercus lyrata-*Carya aquatica* Forest Alliance
Quercus macrocarpa-*Q. bicolor*-(*Carya laciniosa*) Forest Alliance
Quercus palustris-(*Q. bicolor*) Forest Alliance
Quercus phellos-*Quercus lyrata* Forest Alliance
Quercus stellata-(*Q. palustris*) Forest Alliance

<u>WEST</u>
Acer negundo Forest Alliance

Aluns rhombifolia Forest Alliance
Alnus rubra Forest Alliance
Fraxinus latifolia Forest Alliance
Platanus wrightii Forest Alliance
Populus angustifolia Forest Alliance
Populus deltoides Forest Alliance
Populus fremontii Forest Alliance
Populus tremuloides Wetland Forest Alliance
Populus trichocarpa Forest Alliance
Populus wislizeni Forest Alliance
Salix bonplandiana Forest Alliance

I.B.2.f Cold-deciduous seasonally flooded/saturated forest (e.g., deciduous forest in Alaska, peat forests)

<u>EAST</u>
Acer rubrum-Fraxinus pennsylvanica Wetland Forest Alliance
Acer rubrum-Fraxinus nigra Wetland Forest Alliance
Acer rubrum-Nyssa sylvatica Wetland Forest Alliance
Acer rubrum-Liquidambar styraciflua Wetland Forest Alliance

<u>SOUTHEAST</u>
Fraxinus pennsylvanica-(*Ulmus americana*)-*Celtis* (*occidentalis, laevigata*) Forest Alliance
Nyssa biflora-(*Taxodium distichum, ascendens*) Forest Alliance
Nyssa ogeche Forest Alliance
Quercus (*lyrata, nuttallii*)-*Carya aquatica* Forest Alliance
Taxodium ascendens Forest Alliance

<u>MIDWEST</u>
Acer rubrum-(*Fraxinus* spp.) Forest Alliance
Fraxinus nigra Forest Alliance
Larix laricina Forest Alliance

I.B.2.g Cold-deciduous semipermanently flooded forest (e.g., cypress swamp)

<u>EAST</u>
Taxodium distichum-Nyssa biflora Forest Alliance

<u>SOUTHEAST</u>

Acer rubrum-Gleditsia aquatica-(*Planera aquatica*) Forest Alliance
Gleditsia aquatica-Carya aquatica Forest Alliance
Nyssa aquatica-(*Taxodium distichum*) Forest Alliance
Taxodium distichum Forest Alliance

MIDWEST
Acer rubrum-Gleditsia aquatica-(*planera aquatica*) Forest Alliance
Nyssa aquatica-(*taxodium distichum*) Forest Alliance
Taxodium distichum Forest Alliance

I.B.3. EXTREMELY XEROMORPHIC DECIDUOUS FOREST
I.B.3.a Deciduous thorn forest (other formation may be added)

I.C. *MIXED EVERGREEN-DECIDUOUS FOREST*
I.C.1 TROPICAL AND SUBTROPICAL SEMI-DECIDUOUS FOREST
I.C.1.a Tropical or subtropical lowland semi-deciduous forest
I.C.1.b Tropical or subtropical montane or cloud semi-deciduous forest

I.C.2 MIXED BROAD LEAVED EVERGREEN - COLD-DECIDUOUS FOREST

I.C.2.* Cold-deciduous forest with evergreen broad-leaved trees

SOUTHEAST
Fagus grandifolia-Magnolia grandiflora Upland Forest Alliance
Quercus hemisphaerica-Carya glabra-(*Fagus grandifolia*) Forest Alliance
Tilia americana var. *caroliniana-Magnolia grandiflora* Forest Alliance

I.C.2.* Mixed broad-leaved evergreen - cold-deciduous seasonally flooded/saturated forest

SOUTHEAST
Magnolia virginiana-Nyssa biflora Wetland Forest Alliance

I.C.3 MIXED NEEDLE-LEAVED EVERGREEN - COLD-DECIDUOUS FOREST
I.C.3.a Mixed needle-leaved evergreen - cold-deciduous forest

EAST
Quercus-Pinus (*rigida*, *echinata*) Forest Alliance
Pinus virginiana-Pinus taeda-Quercus falcata Forest Alliance

Pinus virginiana/*Quercus marilandica* Forest Alliance
Pinus taeda-Quercus (*nigra, falcata*) Forest Alliance
Pinus strobus-Quercus (*rubra, velutina*) Forest Alliance
Tsuga canadensis-Acer saccharum-Betula allegheniensis Forest Alliance
Betula allegheniensis-Picea rubens Forest Alliance

<u>SOUTHEAST</u>
Betula alleghaniensis-(*Abies fraseri, Picea rubens*) Forest Alliance
Juniperus virginiana var. *virginiana-Fraxinus americana-Quercus shumardii* Forest Alliance
Juniperus virginiana var. *virginiana-Quercus stellata-Quercus muehlenbergii* Forest Alliance
Pinus echinata-Quercus (*alba, stellata, falcata, velutina*) Forest Alliance
Pinus echinata-Quercus stellata-Quercus marilandica Forest Alliance
Pinus (*echinata, rigida, pungens*)-*Quercus* (*prinus, coccinea*) Forest Alliance
Pinus (*echinata, taeda, virginiana*)-*Quercus* (*alba, rubra*)-*Liriodendron tulipifera* Forest Alliance
Pinus (*echinata, virginiana*)-*Liriodendron tulipifera* Forest Alliance
Pinus (*glabra, taeda*)-*Fagus grandifolia-Quercus alba-Magnolia grandiflora* Forest Alliance
Pinus palustris-Pinus echinata-Quercus (*stellata, falcata*) Forest Alliance
Pinus palustris-Pinus echinata-Pinus taeda-Quercus (*stellata, falcata*) Forest Alliance
Pinus palustris-Pinus taeda-Quercus incana Forest Alliance
Pinus (*palustris, taeda*)-*Quercus* (*margaretta, falcata, laevis*) Forest Alliance
Pinus strobus-Acer saccharum-Fagus grandifolia-Betula (*alleghaniensis, lenta*) Forest Alliance
Pinus taeda-Liquidambar styraciflua Upland Forest Alliance
Pinus taeda-Quercus (*alba, falcata, stellata*) Forest Alliance
Pinus taeda-Quercus (*marilandica, falcata, stellata*) Forest Alliance
Pinus taeda-Quercus nigra Barrier Island Forest Alliance
Pinus virginiana-Liquidambar styraciflua-Liriodendron tulipifera Forest Alliance
Pinus virginiana-Quercus (*alba, stellata, falcata, velutina*) Forest Alliance
Pinus virginiana-Quercus (*coccinea, prinus*) Forest Alliance
Quercus falcata-Fagus grandifolia-Pinus taeda Forest Alliance
Sorbus americana-(*Abies fraseri, Picea rubens*) Forest Alliance
Tsuga canadensis-Liriodendron tulipifera Upland Forest Alliance
Tsuga canadensis-Acer saccharum-Fagus grandifolia-Betula (*alleghaniensis, lenta, papyrifera*) Forest Alliance

<u>MIDWEST</u>
Juniperus virginiana-Quercus spp. (*muehlenbergii*, *stellata*) Forest Alliance
Picea glauca-Abies balsamea-Populus spp. Forest Alliance
Picea mariana-Populus tremuloides Forest Alliance
Pinus banksiana-Populus tremuloides-Betula Papyrifera Forest Alliance
Pinus banksiana-Quercus spp. Forest Alliance
Pinus echinata-Quercus spp. (*alba*, *stellata*, *velutina*) Forest Alliance
Pinus strobus-(*P. resinosa*)-*Populus tremuloides* Forest Alliance
Pinus strobus-(*P. resinosa*)-*Quercus* spp. (*alba*, *rubra*, *velutina*) Forest Alliance
Pinus virginiana-Quercus spp.(*coccinea*, *prinus*) Forest Alliance
Tsuga canadensis-Fagus grandifolia-Acer Saccharum Betula spp. Forest Alliance

<u>WEST</u>
Acer macrophyllum Forest Alliance
Betula papyrifera Forest Alliance
Laris lyallii Forest Alliance
Populus tremuloides Forest Alliance
Quercus garryana Forest Alliance

I.C.3.b Mixed needle-leaved evergreen - cold-deciduous seasonally flooded/saturated forest

<u>EAST</u>
Chamaecyparis thyoides-Acer rubrum Forest Alliance
Acer rubrum-Picea rubens Wetland Forest Alliance
Thuja occidentalis-Acer rubrum Wetland Forest Alliance
Quercus phellos-Pinus taeda Wetland Forest Alliance

<u>SOUTHEAST</u>
Pinus taeda-Liquidambar styraciflua-Acer rubrum Wetland Forest Alliance

<u>MIDWEST</u>
Pinus spp.-*Acer rubrum* swamp Forest Alliance

I.C.3.* Mixed needle-leaved evergreen - cold-deciduous seasonally/temporarily flooded forest

<u>SOUTHEAST</u>

Pinus elliottii-Magnolia virginiana-Taxodium ascendens-Nyssa biflora Forest Alliance
Pinus glabra-Pinus taeda-Liquidambar styraciflua-Quercus phellos Wetland Forest Alliance
Pinus serotina-Chamaecyparis thyoides-Acer rubrum-Nyssa biflora Forest Alliance
Pinus taeda-Liquidambar styraciflua-Liriodendron tulipifera Wetland Forest Alliance
Pinus taeda-Fraxinus pennsylvanica-Ulmus americana-Celtis laevigata Forest Alliance
Pinus taeda-Quercus laurifolia-Chamaecyparis thyoides Forest Alliance
Pinus taeda-Quercus lyrata Forest Alliance
Pinus taeda-Quercus (*pagoda, michauxii, shumardii*) Wetland Forest Alliance
Pinus taeda-Quercus (*phellos, nigra, laurifolia*) Forest Alliance
Pinus virginiana-Liriodendron tulipifera-Platanus occidentalis Forest Alliance
Tsuga canadensis-Magnolia tripetala Wetland Forest Alliance

WEST
Quercus garryana Wetland Forest Alliance

I.C.3.* Mixed needle-leaved evergreen - cold-deciduous saturated forest

SOUTHEAST
Chamaecyparis thyoides-Liriodendron tulipifera Forest Alliance
Pinus strobus-Pinus rigida-Tsuga canadensis-Liriodendron tulipifera-Acer rubrum Forest Alliance

I.C.4 EXTREMELY XEROMORPHIC MIXED EVERGREEN - DECIDUOUS FOREST
I.C.4.a Mixed evergreen - deciduous thorn forest

II. **WOODLAND**
II.A. *EVERGREEN WOODLAND*
II.A.1 BROAD-LEAVED EVERGREEN WOODLAND
II.A.1.a Broad-leaved evergreen woodland

SOUTHEAST
Quercus laceyi Woodland Alliance
Quercus virginiana Upland Woodland Alliance
Quercus virginiana-Sabal palmetto Upland Woodland Alliance
Sabal palmetto Upland Woodland Alliance

WEST
Quercus arizonica Woodland Alliance
Quercus emoryi Woodland Alliance
Quercus grisea Woodland Alliance

II.A.1.b Broad-leaved evergreen (wetland) woodland

SOUTHEAST
Sabal palmetto Wetland Woodland Alliance
Gordonia lasianthus-Pinus serotina Woodland alliance

II.A.2 NEEDLE-LEAVED EVERGREEN WOODLAND
II.A.2.a Needle-leaved evergreen woodland with rounded crowns (e.g., pine, western juniper)

EAST
Pinus rigida/*Quercus ilicifolia* Woodland Alliance
Pinus palustris/*Quercus laevis* Woodland Alliance
Pinus (*banksiana*, *resinosa*, *rigida*) Woodland Alliance

SOUTHEAST
Pinus clausa Woodland Alliance
Pinus echinata Upland Woodland Alliance
Pinus echinata-Pinus rigida Woodland Alliance
Pinus echinata-Pinus virginiana Woodland Alliance
Pinus echinata-Pinus taeda-Pinus virginiana Woodland Alliance
Pinus echinata-Pinus taeda-Pinus palustris-Pinus virginiana Woodland Alliance
Pinus elliottii-Pinus (*taeda*, *palustris*, *echinata*) Upland Woodland Alliance
Pinus elliottii var. *densa* Upland Woodland Alliance
Pinus palustris Upland Woodland Alliance
Pinus palustris-Pinus clausa Woodland Alliance
Pinus palustris-Pinus echinata Woodland Alliance
Pinus palustris-Pinus taeda Upland Woodland Alliance
Pinus palustris-Pinus taeda-Pinus echinata Woodland Alliance
Pinus pungens Woodland Alliance
Pinus rigida Woodland Alliance
Pinus rigida-Pinus pungens Woodland Alliance
Pinus taeda Upland Woodland Alliance

Pinus taeda-Pinus echinata Woodland Alliance
Pinus virginiana Woodland Alliance
Pinus virginiana-Pinus rigida Woodland Alliance

MIDWEST
Juniperus ashei Woodland Alliance
Juniperus scopulorum Woodland Alliance
Juniperus virginiana Woodland Alliance
Pinus banksiana Woodland Alliance
Pinus echinata Woodland Alliance
Pinus flexilis Woodland Alliance
Pinus ponderosa Woodland Alliance
Pinus strobus-Pinus resinosa Woodland Alliance

WEST
Juniperus deppeana Woodland Alliance
Juniperus erythrocarpa Woodland Alliance
Juniperus monosperma Woodland Alliance
Juniperus occidentalis Woodland Alliance
Juniperus osteosperma Woodland Alliance
Juniperus scopulorum Woodland Alliance
Pinus albicaulis Woodland Alliance
Pinus aristata Woodland Alliance
Pinus attenuata Woodland Alliance
Pinus contorta Woodland Alliance
Pinus discolor Woodland Alliance
Pinus edulis Woodland Alliance
Pinus engelmannii Woodland Alliance
Pinus flexilis Woodland Alliance
Pinus jeffreyi Woodland Alliance
Pinus leiophylla Woodland Alliance
Pinus monophylla Woodland Alliance
Pinus ponderosa Woodland Alliance
Pinus ponderosa-Quercus garryana Woodland Alliance

II.A.2.b Needle-leaved evergreen woodland with conical crowns (e.g., spruce in the west)

EAST
Picea rubens Woodland Alliance

Thuja occidentalis Woodland Alliance

SOUTHEAST
Juniperus ashei Woodland Alliance
Juniperus virginiana Woodland Alliance
Thuja occidentalis Upland Woodland Alliance
Tsuga caroliniana Woodland Alliance

MIDWEST
Thuja occidentalis Woodland Alliance

WEST
Abies concolor Woodland Alliance
Picea engelmannii Woodland Alliance
Picea pungens Woodland Alliance
Pseudotsuga menziesii Woodland Alliance
Tsuga heterophylla Woodland Alliance
Tsuga mertensiana Woodland Alliance

II.A.2.c Needle-leaved evergreen woodland with very narrow cylindro-conical crowns (e.g., some spruce in Alaska)

II.A.2.d Needle-leaved evergreen seasonally flooded/saturated woodland with rounded crowns

EAST
Pinus rigida Wetland Woodland Alliance
Pinus strobus Wetland Woodland Alliance

SOUTHEAST
Pinus elliottii var. *densa* Wetland Woodland Alliance
Pinus serotina Woodland Alliance
Pinus serotina-Pinus elliottii Woodland Alliance
Pinus serotina-Pinus taeda Wetland Woodland Alliance

WEST
Abies grandis Woodland Alliance
Abies lasiocarpa Woodland Alliance

II.A.2.e Needle-leaved evergreen seasonally flooded/temporarily flooded woodland with rounded crowns

EAST
Pinus serotina Wetland Woodland Alliance

SOUTHEAST
Pinus echinata Wetland Woodland Alliance
Pinus elliottii Wetland Woodland Alliance
Pinus palustris Wetland Woodland Alliance
Pinus palustris-Pinus elliottii Woodland Alliance
Pinus palustris-Pinus serotina Woodland Alliance
Pinus palustris-Pinus taeda Wetland Woodland Alliance

WEST
Pinus ponderosa Wetland Woodland Alliance

II.A.2.f Needle-leaved evergreen seasonally flooded/saturated woodland with conical crowns

EAST
Chamaecyparis thyoides Wetland Woodland Alliance
Picea rubens Wetland Woodland Alliance
Picea mariana Wetland Woodland Alliance

II.A.2.g Needle-leaved evergreen saturated woodland with conical crowns (e.g., black spruce bogs)

SOUTHEAST
Picea rubens Wetland Woodland Alliance
Thuja occidentalis Wetland Woodland Alliance

MIDWEST
Picea mariana Woodland Alliance

II.A.2.h Needle-leaved evergreen seasonally flooded/saturated woodland with cylindro-conical crowns

II.A.2.* Needle-leaved evergreen seasonally/temporarily flooded woodland

WEST
Abies concolor Wetland Woodland Alliance
Picea pungens Wetland Woodland Alliance

II.A.3 EXTREMELY XEROMORPHIC EVERGREEN WOODLAND
II.A.3.a Evergreen sclerophyllous woodland
II.A.3.b Evergreen succulent woodland (assumed evergreen)

II.B. *DECIDUOUS WOODLAND*
II.B.1 TROPICAL AND SUBTROPICAL DROUGHT-DECIDUOUS WOODLAND
II.B.1.a Lowland and submontane broad-leaved drought-deciduous woodland
II.B.1.b Montane (and cloud) drought-deciduous woodland

II.B.2 COLD-DECIDUOUS WOODLAND
II.B.2.a Cold-deciduous woodland

EAST
Quercus muehlenbergii Woodland Alliance
Tilia americana-Fraxinus americana Woodland Alliance
Quercus rubra Woodland Alliance
Quercus velutina-Quercus alba Woodland Alliance

SOUTHEAST
Acer saccharum-Quercus muehlenbergii Woodland Alliance
Populus fremontii Woodland Alliance
Quercus arkansana Woodland Alliance
Quercus hemisphaerica-Quercus margaretta Woodland Alliance
Quercus incana Woodland Alliance
Quercus laevis Woodland Alliance
Quercus muehlenbergii-(*Quercus macrocarpa*) Woodland Alliance
Quercus prinus Woodland Alliance
Quercus prinus-Quercus coccinea Woodland Alliance
Quercus stellata Woodland Alliance
Quercus stellata-Quercus marilandica Woodland Alliance
Quercus stellata-Quercus velutina-Quercus alba-(*Quercus falcata*) Woodland Alliance
Quercus velutina-Quercus alba-Carya (*texana, glabra*) Woodland Alliance
Robinia pseudo-acacia Woodland Alliance

MIDWEST
Betual papyrifera Woodland Alliance
Fraxinus pennsylvanica-(*Ulmus americana*) Woodland Alliance
Populus Tremuloides Woodland Alliance
Quercus alba Woodland Alliance

Quercus macrocarpa Woodland Alliance
Quercus macrocarpa-Quercus spp.(*alba*, *velutina*) Woodland Alliance
Quercus muehlenbergii Woodland Alliance
Quercus stellata-Q. marilandica Woodland Alliance
Quercus stellata-Q. velutina-Q. alba-(*Q. falcata*) Woodland Alliance
Quercus velutina-Q. ellipsoidalis Woodland Alliance

<u>WEST</u>
Populus angustifolia Woodland Alliance
Populus fremontii Woodland Alliance
Populus tremuloides Woodland Alliance
Salix amygdaloides Woodland Alliance
Salix laevigata Woodland Alliance
Larix lyallii Woodland Alliance

II.B.2.b Cold-deciduous intermittently flooded woodland
II.B.2.c Cold-deciduous seasonally/temporarily flooded woodland

<u>SOUTHEAST</u>
Acer negundo Woodland Alliance
Acer negundo-Salix nigra Woodland Alliance
Salix gooddingii Wetland Woodland Alliance
Salix (*nigra, caroliniana*) Woodland Alliance

<u>MIDWEST</u>
Populus deltoides Woodland Alliance

<u>WEST</u>
Acer negundo Woodland Alliance
Platanus wrightii Woodland Alliance
Populus deltoides Woodland Alliance

II.B.2.d Cold-deciduous seasonally flooded/saturated woodland

II.B.3 EXTREMELY XEROMORPHIC DECIDUOUS WOODLAND
II.B.3.a Deciduous thorn woodland (may not be represented in the U.S.)

II.C. *MIXED EVERGREEN-DECIDUOUS WOODLAND*
II.C.1 TROPICAL AND SUBTROPICAL SEMI-DECIDUOUS WOODLAND

II.C.2 MIXED BROAD-LEAVED EVERGREEN - COLD DECIDUOUS WOODLAND

WEST
Quercus chrysolepsis Woodland Alliance
Quercus garryana Woodland Alliance

II.C.3 MIXED NEEDLE-LEAVED EVERGREEN - COLD-DECIDUOUS WOODLAND
II.C.3.a Mixed needle-leaved evergreen - cold-deciduous woodland

EAST
Juniperus virginiana-Fraxinus americana Woodland Alliance
Quercus (*coccinea, velutina*)-*Pinus rigida* Woodland Alliance

SOUTHEAST
Juniperus virginiana var. *virginiana-Quercus muehlenbergii* Woodland Alliance
Pinus echinata/*Quercus incana* Woodland Alliance
Pinus echinata-Pinus rigida-Quercus prinus Woodland Alliance
Pinus echinata-Quercus (*alba, stellata, falcata, velutina*) Woodland Alliance
Pinus echinata-Quercus (*prinus, coccinea*) Woodland Alliance
Pinus echinata-Quercus stellata-Quercus marilandica Woodland Alliance
Pinus palustris/*Quercus falcata-Carya texana* Woodland Alliance
Pinus palustris/*Quercus incana* Woodland Alliance
Pinus (*rigida, pungens, virginiana*) *Quercus* (*prinus, coccinea*) Woodland Alliance

MIDWEST
Pinus banksiana-Quercus spp. (*Q. velutina-Q. ellipsoidalis*) Woodland Alliance
Pinus echinata-Quercus spp.(*alba, stellata, velutina*) Woodland Alliance
Pinus echinata-Quercus spp. (*coccinea,prinus*) Woodland Alliance
Pinus strobus-Quercus alba Woodland Alliance

WEST
Populus angustifolia Woodland Alliance

II.C.3.b Mixed needle-leaved evergreen - cold-deciduous seasonally flooded/saturated woodland
II.C.3.* Mixed needle-leaved evergreen - cold-deciduous saturated woodland

EAST
Fraxinus nigra-Abies balsamea Wetland Woodland Alliance

II.C.4 EXTREMELY XEROMORPHIC MIXED EVERGREEN - DECIDUOUS WOODLAND

II.C.4.a Mixed evergreen-deciduous thorn woodland

SOUTHEAST

Pinus strobus-Acer rubrum Wetland Woodland Alliance

II.B.4.* Cold-deciduous freshwater tidal regularly flooded woodland

EAST

Acer rubrum - Fraxinus pennsylvanica Wetland Woodland Alliance

II.B.4.* Cold-deciduous saturated woodland

EAST

Acer rubrum Wetland Woodland Alliance

III **SPARSE WOODLAND**

III.A. *EVERGREEN SPARSE WOODLAND*

III.A.1 BROAD-LEAVED EVERGREEN SPARSE WOODLAND WITH A DOMINANT HERBACEOUS STRATUM

III.A.1.a Broad-leaved evergreen sparse woodland with tall graminoids (includes tuft plants)

SOUTHEAST

Sabal palmetto/*Muhlenbergia capillaris* Upland Sparse Woodland Alliance

III.A.1.b Broad-leaved evergreen sparse wooldand with medium tall graminoids (includes tuft plants)

III.A.1.c Broad-leaved evergreen sparse woodland with short graminoids (includes tuft plants)

III.A.1.d Broad-leaved evergreen seasonally flooded sparse wooldand with tall graminoids (includes tuft plants)

III.A.1.e Broad-leaved evergreen seasonally flooded sparse wooldand with medium tall graminoids (includes tuft plants)

III.A.1.f Broad-leaved evergreen seasonally flooded sparse wooldand with short graminoids (includes tuft plants)

III.A.2 NEEDLE-LEAVED EVERGREEN SPARSE WOODLAND WITH A DOMINANT SHRUB STRATUM

III.A.2.a Needle-leaved evergreen sparse woodland with deciduous or mixed shrubs (e.g., pitch pine-scrub oak)

EAST
Pinus rigida/*Quercus ilicifolia-Rhododendron canadense* Sparse Woodland Alliance

III.A.2.b Needle-leaved evergreen saturated sparse woodland with evergreen shrubs (e.g., pocosins)
III.A.2.c Needle-leaved evergreen saturated sparse woodland with deciduous or mixed evergreen shrubs (e.g., pocosins)

SOUTHEAST
Picea rubens/*Ilex collina* Sparse Wetland Woodland Alliance
Picea rubens/*Kalmia carolina* Sparse Wetland Woodland Alliance

III.A.3 NEEDLE-LEAVED EVERGREEN SPARSE WOODLAND WITH DOMINANT DWARF SHRUB STRATUM
III.A.3.a Needle-leaved evergreen sparse woodland with microphyllous dwarf shrubs
III.A.3.b Needle-leaved evergreen sparse woodland with evergreen dwarf shrubs
III.A.3.c Needle-leaved evergreen saturated sparse woodland with evergreen dwarf shrubs

III.A.3.* Needle-leaved evergreen sparse woodland with broad-leaved dwarf shrubs

EAST
Picea mariana/*Kalmia-Ledum* Sparse Woodland Alliance

III.A.4 NEEDLE-LEAVED EVERGREEN SPARSE WOODLAND WITH A DOMINANT HERBACEOUS STRATUM
III.A.4.a Needle-leaved evergreen sparse woodland with medium tall graminoids (e.g., serpentine barrens, jack pine barrens)

EAST
Pinus (*virginiana, rigida*)/*Schizachyrium scoparium* Sparse Woodland Alliance

SOUTHEAST
Juniperus virginiana var. *virginiana*/*Schizachyrium scoparium* Sparse Woodland Alliance

Pinus echinata-Pinus taeda/*Schizachyrium scoparium* Sparse Woodland Alliance
Pinus echinata-(*Pinus virginiana*)/*Schizachyrium scoparium* Sparse Woodland Alliance
Pinus elliottii var. *densa/*Sparse Woodland Alliance
Pinus palustris/medium-tall grass Sparse Upland Woodland Alliance
Pinus virginiana-(*Pinus rigida*)/*Schizachyrium scoparium* Sparse Woodland Alliance

<u>MIDWEST</u>
Pinus banksiana-(*Pinus resinosa*) Sparse Woodland Alliance
Pinus ponderosa Sparse Woodland Alliance?

III.A.4.b Needle-leaved evergreen (wetland) sparse woodland with tall graminoids

<u>SOUTHEAST</u>
Pinus elliottii/*Ctenium aromaticum* Sparse Woodland Alliance
Pinus elliottii-Pinus palustris/tallgrass Sparse Woodland Alliance
Pinus palustris/*Ctenium aromaticum* Sparse Woodland Alliance
Pinus palustris-Pinus serotina/tallgrass Sparse Woodland Alliance
Pinus serotina/*Arundinaria gigantea* Sparse Woodland Alliance

III.A.4.c Needle-leaved evergreen (wetland) sparse woodland with medium tall graminoids

<u>SOUTHEAST</u>
Pinus elliottii var. *densa/*?? Sparse Wetland Woodland Alliance

III.A.5 NEEDLE-LEAVED EVERGREEN SPARSE WOODLAND WITH A DOMINANT NON-VASCULAR STRATUM
III.A.5.a Needle-leaved evergreen sparse woodland with lichen cover

<u>MIDWEST</u>
Pinus banksiana Sparse Woodland Alliance

III.A.5.b Needle-leaved evergreen saturated sparse woodland with moss cover

III.A.6 NEEDLE-LEAVED EVERGREEN SPARSE WOODLAND WITH A SPARSELY-VEGETATED GROUND LAYER
III.A.6.a Needle-leaved evergreen sparse (wetland) woodland on mudflats

III.A.6.* Needle-leaved evergreen sparse woodland on rocky substrates

SOUTHEAST
Juniperus virginiana var. *virginiana/*Limestone Sparse Woodland Alliance

III.A.7 EXTREMELY XEROMORPHIC EVERGREEN SPARSE WOODLAND (lower strata undefined)

III.B. *DECIDUOUS SPARSE WOODLAND*
III.B.1 TROPICAL AND SUBTROPICAL DROUGHT-DECIDUOUS SPARSE WOODLAND (lower strata undefined)

III.B.2 COLD-DECIDUOUS SPARSE WOODLAND WITH A DOMINANT HERBACEOUS STRATUM
III.B.2.a Cold-deciduous sparse woodland with tall graminoids

SOUTHEAST
Fraxinus quadrangulata-Quercus macrocarpa Sparse Woodland Alliance
Populus deltoides/tallgrass Sparse Upland Woodland Alliance
Quercus muehlenbergii/tallgrass Sparse Woodland Alliance

MIDWEST
Populus deltoides Sparse Woodland Alliance
Populus tremuloides tallgrass Sparse Woodland Alliance
Quercus alba-Q. palustris Sparse Woodland Alliance
Quercus macrocarpa-Quercus spp. (*alba*, *velutina*, *stellata*) Sparse Woodland Alliance
Quercus velutina-Q. ellipsoidalis Sparse Woodland Alliance

III.B.2.b Cold-deciduous sparse woodland with medium tall graminoids

SOUTHEAST
Quercus alba-Quercus coccinea-Quercus velutina/*Schizachyrium scoparium* Sparse Woodland Alliance
Quercus stellata-Quercus marilandica Sparse Woodland Alliance
Quercus stellata-Quercus velutina-Quercus alba-(*Quercus falcata*) Sparse Woodland Alliance

MIDWEST
Populus tremuloides Sparse Woodland Alliance

Quercus macrocarpa Sparse Woodland Alliance
Quercus stellata-Q. marilandica Sparse Woodland Alliance
Quercus stellata-Q. velutina-Q. alba-(*Q. falcata*) Sparse Woodland Alliance

III.B.2.c Cold-deciduous sparse woodland with short graminoids
III.B.2.d Cold-deciduous seasonally flooded sparse woodland with tall graminoids.

<u>WEST</u>
Populus deltoides Sparse Woodland Alliance
Populus fremontii Sparse Woodland Alliance

III.B.2.* Cold-deciduous seasonally flooded/saturated sparse woodland with tall graminoids

<u>SOUTHEAST</u>
Taxodium ascendens Sparse Woodland Alliance

III.B.3 COLD-DECIDUOUS SPARSE WOODLAND WITH A SPARSELY-VEGETATED GROUND LAYER
III.B.3.a Cold-deciduous sparse woodland on rocky substrate

<u>SOUTHEAST</u>
Quercus coccinea-Quercus prinus/(Sandstone, Shale) Sparse Woodland Alliance
Quercus muehlenbergii-Fraxinus quadrangulata-Acer saccharum/Limestone Sparse Woodland Alliance

III.B.4 EXTREMELY XEROMORPHIC DECIDUOUS SPARSE WOODLAND (lower strata undefined)

III.B.* Cold-deciduous sparse woodland with a dominant shrub stratum
III.B.* Cold-deciduous saturated sparse woodland with evergreen shrubs

<u>SOUTHEAST</u>
Liriodendron tulipifera/*Rhododendron maximum* Sparse Wetland Woodland Alliance

III.C. *MIXED EVERGREEN-DECIDUOUS SPARSE WOODLAND*
III.C.1 BROAD-LEAVED SEMI-EVERGREEN SPARSE WOODLAND WITH A DOMINANT HERBACEOUS STRATUM

III.C.1.a Broad-leaved semi-evergreen sparse woodland with tall graminoids
III.C.1.b Broad-leaved semi-evergreen sparse woodland with medium tall graminoids
III.C.1.c Broad-leaved semi-evergreen sparse woodland with short graminoids

III.C.2 MIXED NEEDLE-LEAVED EVERGREEN - COLD-DECIDUOUS SPARSE WOODLAND

III.C.2.a Mixed needle-leaved evergreen - cold-deciduous saturated sparse woodland with evergreen shrubs (e.g., pocosins)

III.C.3 MIXED NEEDLE-LEAVED EVERGREEN - COLD-DECIDUOUS SPARSE WOODLAND WITH A DOMINANT HERBACEOUS STRATUM

III.C.3.a Mixed needle-leaved evergreen - cold-deciduous sparse woodland with tall graminoids

III.C.3.b Mixed needle-leaved evergreen - cold-deciduous sparse woodland with medium tall graminoids

<u>SOUTHEAST</u>
Pinus (*virginiana, echinata*)-*Quercus* (*coccinea, alba, velutina*)/*Schizachyrium scoparium* Sparse Woodland Alliance

<u>MIDWEST</u>
Pinus banksiana-Quercus spp. (*velutina, ellipsoidalis*) Sparse Woodland Alliance
Pinus ponderosa-Quercus macrocarpa Sparse Woodland Alliance
Pinus strobus-Quercus alba Sparse Woodland Alliance

III.C.3.c Mixed needle-leaved evergreen - cold-deciduous (wetland) sparse woodland with forbs

<u>SOUTHEAST</u>
Pinus rigida-Nyssa sylvatica Sparse Wetland Woodland Alliance

III.C.4 MIXED EVERGREEN - DECIDUOUS EXTREMELY XEROMORPHIC SPARSE WOODLAND (lower strata undefined)

III.C.* Mixed needle-leaved evergreen - cold-deciduous sparse woodland with a sparsely vegetated ground layer

III.C.* Mixed needle-leaved evergreen - cold-deciduous sparse woodland on rocky substrates

SOUTHEAST
Juniperus virginiana-(*Quercus muehlenbergii, Fraxinus quadrangulata, Acer saccharum*) Limestone Sparse Woodland Alliance

IV. **SHRUBLAND (SCRUB)**
IV.A. *EVERGREEN SHRUBLAND*
IV.A.1 BROAD-LEAVED EVERGREEN SHRUBLAND
IV.A.1.a Evergreen low bamboo shrubland
IV.A.1.b Evergreen tuft-tree shrubland

SOUTHEAST
Serenoa repens Upland Shrubland Alliance

IV.A.1.c Broad-leaved evergreen hemisclerophyllous shrubland

SOUTHEAST
Baccharis halimifolia Shrubland Alliance
Quercus chapmanii Shrubland Alliance
Quercus havardii Shrubland Alliance
Ilex vomitoria-Myrica cerifera Upland Shrubland Alliance

IV.A.1.d Broad-leaved evergreen sclerophyllous shrubland

SOUTHEAST
Ceratiola ericoides Shrubland Alliance
Pithecellobium ebano-Phaulothamnus spinescens Shrubland Alliance
Quercus myrtifolia-Serenoa repens Shrubland Alliance
Rhododendron catawbiense Shrubland Alliance
Rhododendron maximum Shrubland Alliance
Rhododendron maximum-Kalmia latifolia Shrubland Alliance

MIDWEST
Ceanothus velutinous Shrubland Alliance?

WEST
Ambrosia deltoidea Shrubland Alliance
Arctostaphylos patula Shrubland Alliance
Arctostaphylos pungens Shrubland Alliance
Arctostaphylos viscida Shrubland Alliance

Cercocarpus ledifolius Shrubland Alliance
Gaultheria shallon Shrubland Alliance
Quercus oblongifolia Shrubland Alliance
Quercus toumeyi Shrubland Alliance
Quercus turbinella Shrubland Alliance
Simmondsia chinensis Shrubland Alliance

IV.A.1.e Evergreen suffruticose shrubland
IV.A.1.f Broad-leaved evergreen (wetland) shrubland

SOUTHEAST
Cyrilla racemiflora Shrubland Alliance
Hypericum fasciculatum Shrubland Alliance

IV.A.2 NEEDLE-LEAVED EVERGREEN SHRUBLAND
IV.A.2.a Needle-leaved evergreen shrubland (e.g., krumholtz)

EAST
Picea mariana-Abies balsamea Shrubland Alliance

SOUTHEAST
Juniperus communis Shrubland Alliance
Juniperus virginiana var. *virginiana* Shrubland Alliance
Pinus taeda Upland Shrubland Alliance

MIDWEST
Juniperus communis Shrubland Alliance

WEST
Abies lasiocarpa Shrubland Alliance

IV.A.2.b Needle-leaved evergreen shrubland (e.g., scrub bog)

IV.A.3 MICROPHYLLOUS EVERGREEN SHRUBLAND (e.g., sagebrush)

MIDWEST
Aretmisia cana ssp. *cana* Shrubland Alliance
Artemisia longifolia Shrubalnd Alliance
Artemisia tridentata Shrubland Alliance

WEST
Artemisia bigelovii Shrubland Alliance
Artemisia tridentata Shrubland Alliance
Artemisia tridentata ssp. *tridentata* Shrubland Alliance
Artemisia tridentata ssp. *vaseyana* Shrubland Alliance
Artemisia tridentata ssp. *wyomingensis* Shrubland Alliance
Cowania mexicana Shrubland Alliance
Purshia tridentata Shrubland Alliance

IV.A.3.* Microphyllous evergreen seasonally/temporarily flooded Shrubland

WEST
Allenrolfea occidentalis Shrubland Alliance

IV.A.4 EXTREMELY XEROMORPHIC EVERGREEN SHRUBLAND
IV.A.4.a Evergreen subdesert shrubland (e.g., cresote bush)

WEST
Encelia farinosa Shrubland Alliance
Ephedra nevadensis Shrubland Alliance
Ephedra nevadensis-Ephedra viridis Shrubland Alliance
Ephedra viridis Shrubland Alliance
Eriogonum fasciculatum Shrubland Alliance
Larrea tridentata Shrubland Alliance
Mortonia scabrella Shrubland Alliance

IV.B. *DECIDUOUS SHRUBLAND (SCRUB)*
IV.B.1 DROUGHT-DECIDUOUS SHRUBLAND

IV.B.2 COLD-DECIDUOUS SHRUBLAND
IV.B.2.a Temperate deciduous shrubland (e.g., serviceberry, some oaks)

EAST
Myrica pensylvanica-Prunus maritima Shrubland Alliance

SOUTHEAST
Quercus alba Shrubland Alliance
Quercus ilicifolia Shrubland Alliance
Quercus stellata Shrubland Alliance
Vaccinium vacillans Shrubland Alliance

MIDWEST

Amelanchier alnifolia Shrubland Alliance
Artemisia filifolia Shrubland Alliance
Atriplex confertifolia-(*Sarcobatis vermiculatus*) Shrubland Alliance
Betula occidentalis Shrubland Alliance
Cercocarpus montanus Shrubland Alliance
Cornus racemosa-C. drummondii-Rhus glabra Shrubland Alliance?
Corylus americana-Rhus spp.-*Salix humilis* Shrubland Alliance
Malus ioensis-Crataegus spp. Shrubland Alliance?
Pentaphylloides floribunda Shrubland Alliance
Populus tremuloides-Quercus spp.-*Salix* spp. Shrubland Alliance
Prunus americana Shrubland Alliance?
Quercus marilandica scrub Alliance
Shepherdia argentea Shrubland Alliance
Symphoricarpos occidentalis Shrubland Alliance

WEST

Acer glabrum Shrubland Alliance
Amelanchier alnifolia Shrubland Alliance
Amelanchier utahensis Shrubland Alliance
Artemisia cana Shrubland Alliance
Artemisia cana ssp. *viscidula* Shrubland Alliance
Artemisia filifolia Shrubland Alliance
Betula glandulosa Shrubland Alliance
Celtis reticulata Shrubland Alliance
Cercocarpus montanus Shrubland Alliance
Crataegus douglasii Shrubland Alliance
Elaeagnus commutata Shrubland Alliance
Glossopetalon nevadense Shrubland Alliance
Juglans major Shrubland Alliance
Juglans microcarpa Shrubland Alliance
Physocarpus malvaceus Shrubland Alliance
Potentilla fruticosa Shrubland Alliance
Quercus gambelii Shrubland Alliance
Quercus undulata Shrubland Alliance
Rhus aromatica Shrubland Alliance
Rhus glabra Shrubland Alliance
Rhus virens var. *choriophylla* Shrubland Alliance
Ribes cereum Shrubland Alliance

Robinia neomexicana Shrubland Alliance
Rubus parviflorus Shrubland Alliance
Spiraea douglasii Shrubland Alliance
Symphoricarpos albus Shrubland Alliance

IV.B.2.b Subalpine or subpolar deciduous shrubland (e.g., willow, alder)

WEST
Rhamnus alnifolia Shrubland Alliance
Salix brachycarpa Shrubland Alliance
Salix glauca Shrubland Alliance
Salix pseudomonticola Shrubland Alliance
Vaccinium spp. *caespitosum-scoparium* Shrubland Alliance

IV.B.2.c Deciduous seasonally/temporarily flooded shrubland

EAST
Alnus (*incana*, *serrulata*) Shrubland Alliance
Betula nigra Shrubland Alliance
Salix nigra Shrubland Alliance

SOUTHEAST
Alnus serrulata Seasonally/temporarily Flooded Shrubland Alliance
Salix caroliniana Shrubland Alliance

MIDWEST
Salix spp. (*S. exigua*) Shrubland Alliance
Salix spp. Shrubland Alliance Shrub Prairie

WEST
Alnus incana Shrubland Alliance
Alnus oblongifolia Shrubland Alliance
Alnus sinuata Shrubland Alliance
Alnus spp. Shrubland Alliance
Baccharis sarothroides Shrubland Alliance
Betula occidentalis Shrubland Alliance
Celtis reticulata Shrubland Alliance
Chilopsis linearis Shrubland Alliance
Cornus sericea Shrubland Alliance
Crataegus succulenta Shrubland Alliance

Forestiera pubescens Shrubland Alliance
Hymenoclea monogyra Shrubland Alliance
Philadelphus lewisii Shrubland Alliance
Physocarpus malvaceus Shrubland Alliance
Prunus virginiana Shrubland Alliance
Ribes lacustre Shrubland Alliance
Rosa woodsii Shrubland Alliance
Salix bebbiana Shrubland Alliance
Salix boothii Shrubland Alliance
Salix candida Shrubland Alliance
Salix commutata Shrubland Alliance
Salix drummondiana Shrubland Alliance
Salix eastwoodiae Shrubland Alliance
Salix exigua Shrubland Alliance
Salix geyeriana Shrubland Alliance
Salix hookeriana Shrubland Alliance
Salix irrorata Shrubland Alliance
Salix lasiandra Shrubland Alliance
Salix lasiolepis Shrubland Alliance
Salix ligulifolia Shrubland Alliance
Salix lutea Shrubland Alliance
Salix monticola Shrubland Alliance
Salix planifolia Shrubland Alliance
Salix rigida Shrubland Alliance
Shepherdia argentea Shrubland Alliance
Symphoricarpos occidentalis Shrubland Alliance

IV.B.2.d Deciduous seasonally flooded/saturated shrubland
(e.g., blueberry-azalea thickets)

MIDWEST
Alnus incana Shrubland Alliance
Alnus serrulata Shrubland Alliance
Salix bebbiana Shrubland Alliance
Salix spp.-*Cornus sericea* Shrubland Alliance

WEST
Betula occidentalis Shrubland Alliance
Salix wolfii Shrubland Alliance

IV.B.2.e Deciduous saturated shrubland (e.g. on peat)

SOUTHEAST
Alnus serrulata Saturated Shrubland Alliance
Asimina triloba Shrubland Alliance

MIDWEST
Cornus spp.-*Rhus* spp.-*Vaccinium* spp. Saturated Shrubland Alliance
Cornus spp.-*Salix* spp. Saturated Shrubland Alliance
Salix spp.-*Betula pumila* Shrubland Alliance

WEST
Salix brachycarpa Shrubland Alliance
Salix geyeriana Shrubland Alliance
Vaccinium occidentale Shrubland Alliance
Vaccinium uliginosum Shrubland Alliance

IV.B.2.f Deciduous semipermanently flooded shrubland (e.g., butonbush thickets)

EAST
Cephalanthus occidentalis Shrubland Alliance
Cornus (*sericea*/*amomum*)-*Pentaphylloides floribunda* Shrublands (Shrub fens): see *Pentaphylloides floribunda*-*Carex* spp. Sparse Shrubland Alliance
Decodon verticillatus Shrubland Alliance
Vaccinium corymbosum Shrubland Alliance

SOUTHEAST
Cephalanthus occidentalis Shrubland Alliance

MIDWEST
Cephalanthus occidentalis Shrubland Alliance

IV.B.2.g Saltwater-tidal irregularly flooded shrubland (e.g., high tide bush)

EAST
Baccharis halimifolia-*Iva frutescens* Shrubland Alliance

IV.B.3.* Freshwater-tidal irregularly flooded shrubland

EAST
Alnus (*incana*, *serrulata*)-*Cornus amomum* Shrubland Alliance

IV.B.3 EXTREMELY XEROMORPHIC DECIDUOUS SHRUBLAND
IV.B.3.a Deciduous subdesert shrubland without succulents

WEST
Acacia neovernicosa Shrubland Alliance
Eriogonum corymbosum Shrubland Alliance
Grayia spinosa Shrubland Alliance
Psorothamnus polydenius var. *polydenius* Shrubland Alliance
Rhus microphylla Shrubland Alliance
Sarcobatus vermiculatus Shrubland Alliance
Sarcobatus vermiculatus var. *baileyi* Shrubland Alliance

IV.B.3.* Deciduous seasonally/temporarily flooded subdesert Shrubland

WEST
Acacia greggii Shrubland Alliance
Sarcobatus vermiculatus Wetland Shrubland Alliance

IV.C. *MIXED EVERGREEN-DECIDUOUS SHRUBLAND (SCRUB)*
IV.C.1 MIXED EVERGREEN - DROUGHT-DECIDUOUS SHRUBLAND
IV.C.2 MIXED EVERGREEN - COLD-DECIDUOUS SHRUBLAND

IV.C.2.* Mixed evergreen - cold-deciduous shrubland

SOUTHEAST
Gaylussacia brachycera-*Vaccinium arboreum* Shrubland Alliance

IV.C.3 EXTREMELY XEROMORPHIC MIXED EVERGREEN - DECIDUOUS SHRUBLAND
IV.C.3.a Deciduous subdesert shrubland with succulents (e.g., palo verde)

WEST
Cercidium floridum Shrubland Alliance
Cercidium microphyllum Shrubland Alliance
Fouquieria splendens Shrubland Alliance
Lycium berlandieri Shrubland Alliance
Prosopis glandulosa Shrubland Alliance

Prosopis pubescens Shrubland Alliance
Prosopis velutina Shrubland Alliance

IV.C.3.b Facultatively deciduous subdesert shrubland (e.g., saltbush)

WEST
Aloysia wrightii Shrubland Alliance
Atriplex canescens Shrubland Alliance
Atriplex confertifolia Shrubland Alliance
Atriplex cuneata Shrubland Alliance
Atriplex hymenelytra Shrubland Alliance
Atriplex polycarpa Shrubland Alliance
Ceratoides lanata Shrubland Alliance
Chrysothamnus albidus Shrubland Alliance
Chrysothamnus nauseosus Shrubland Alliance
Chrysothamnys parryi Shrubland Alliance
Coleogyne ramosissima Shrubland Alliance
Encelia virginensis Shrubland Alliance
Flourensia cernua Shrubland Alliance
Poliomintha incana Shrubland Alliance

IV.C.3.c Mixed evergreen - deciduous subdesert shrubland

V. **SPARSE SHRUBLAND (SCRUB)**
V.A. *EVERGREEN SPARSE SHRUBLAND (SCRUB)*
V.A.1 BROAD-LEAVED EVERGREEN SPARSE SHRUBLAND WITH A DOMINANT HERBACEOUS STRATUM
V.A.1.a Broad-leaved evergreen sparse shrubland with tall graminoids

WEST
Yucca glauca Sparse Shrubland Alliance

V.A.1.b Broad-leaved evergreen sparse shrubland with medium tall graminoids (including tuft shrubs)

WEST
Purshia tridentata Sparse Shrubland Alliance
Yucca glauca Sparse Shrubland Alliance

SOUTHEAST

Kalmia latifolia/*Schizachyrium scoparium* Sparse Shrubland Alliance
Serenoa repens Upland Sparse Shrubland Alliance

V.A.1.c Broad-leaved evergreen sparse shrubland with short graminoids

WEST
Bouteloua eriopoda Sparse Shrubland Alliance
Carex Stenophylla Sparse Shrubland Alliance
Eriogonum spp. Sparse Shrubland Alliance

V.A.1.d Broad-leaved evergreen saturated sparse shrubland with tall graminoids
V.A.1.e Broad-leaved evergreen saturated sparse shrubland with medium tall graminoids

SOUTHEAST
Ilex (*glabra*, *coriacea*) Sparse Shrubland Alliance

V.A.2 NEEDLE-LEAVED EVERGREEN SPARSE SHRUBLAND WITH A DOMINANT HERBACEOUS STRATUM
V.A.2.a Needle-leaved evergreen sparse shrubland with medium tall graminoids

WEST
Muhlenbergia Setifolia Sparse Shrubland Alliance
Sporobolus Cryptandrus Sparse Shrubland Alliance
Sporobolus nealleyi Sparse Shrubland Alliance

V.A.2.* Cold-deciduous Sparse Shrubland with Tall Graminoids

WEST
Leymus cinereus Sparse Shrubland Alliance

V.A.3 MICROPHYLLOUS EVERGREEN SPARSE SHRUBLAND WITH A DOMINANT HERBACEOUS STRATUM
V.A.3.a Microphyllous evergreen sparse shrubland with tall graminoids

WEST
Artemisia tridentata Sparse Shrubland Alliance

V.A.3.b Microphyllous evergreen sparse shrubland with medium tall graminoids

WEST

Artemisia longifolia Sparse Shrubland Alliance
Artemisia tridentata Sparse Shrubland Alliance
Artemisia tridentata ssp. *vaseyana* Sparse Shrubland Alliance
Artemisia tridentata ssp. *wyomingensis* Sparse Shrubland Alliance
Artemisia tripartita Sparse Shrubland Alliance
Artemisia tripartita ssp. *rupicola* Sparse Shrubland Alliance
Hilaria mutica Sparse Shrubland Alliance
Hilaria rigida Sparse Shrubland Alliance
Muhlenbergia setfolia Sparse Shrubland Alliance
Sporobolus cryptandrus Sparse Shrubland Alliance
Sporobolus nealleyi Sparse Shrubland Alliance

V.A.3.c Microphyllous evergreen sparse shrubland with short graminoids

WEST
Artemisia tridentata ssp. *wyomingensis* Sparse Shrubland Alliance
Bouteloua eriopoda Sparse Shrubland Alliance
Bouteloua gracilis Sparse Shrubland Alliance

V.A.3.d Tropical alpine evergreen tuft plant sparse shrubland with short bunch graminoids (e.g., Paramo)
V.A.3.e Tropical or subtropical alpine evergreen sparse shrubland with short bunch graminoids (e.g., Puna)

V.A.4 EXTREMELY XEROMORPHIC EVERGREEN SPARSE SHRUBLAND WITH A DOMINANT HERBACEOUS STRATUM
V.A.4.a Evergreen sparse shrubland with medium tall graminoids (e.g. Larrea tridentata/Hilaria mutica)

V.B. *DECIDUOUS SPARSE SHRUBLAND (scrub)*
V.B.1 DROUGHT-DECIDUOUS SPARSE SHRUBLAND WITH A DOMINANT HERBACEOUS STRATUM
V.B.1.a Drought-deciduous thorny sparse shrubland with medium tall graminoids (grasses may be 1>m - needs review)

EAST
Myrica pensylvanica-Schizachyrium scoparium Sparse Shrubland

WEST

Prosopis glandulosa Sparse Shrubland Alliance

V.B.1.b Drought-deciduous thorny sparse shrubland with short graminoids

V.B.2 COLD-DECIDUOUS SPARSE SHRUBLAND WITH A DOMINANT HERBACEOUS STRATUM

V.B.2.a Cold-deciduous sparse shrubland with tall graminoids

<u>MIDWEST</u>
Corylus americana-(*Rubus* spp.) Sparse Shrubland Alliance
Populus tremuloides-*Quercus* spp. Sparse Shrubland Alliance

<u>WEST</u>
Artemisia filifolia Sparse Shrubland Alliance
Rhus aromatica Sparse Shrubland Alliance

V.B.2.b Cold-deciduous sparse shrubland with medium tall graminoids

<u>MIDWEST</u>
Rhus aromatica Sparse Shrubland Alliance?
Sarcobatus vermiculatus Sparse Shrubland Alliance
Yucca glauca Sparse Shrubland Alliance

<u>WEST</u>
Artemisia cana Sparse Shrubland Alliance
Artemisia cana ssp. *cana* Sparse Shrubland Alliance
Artemisia filifolia Sparse Shrubland Alliance
Cercocarpus montanus Sparse Shrubland Alliance
Chrysothamnus viscidiflorus Sparse Shrubland Alliance
Festuca idahoensis Sparse Shrubland Alliance
Potentilla fruticosa Sparse Shrubland Alliance
Rhus aromatica Sparse Shrubland Alliance
Rhus glabra Sparse Shrubland *Alliance*
Sarcobatus vermiculatus Sparse Shrubland Alliance

V.B.2.c Cold-deciduous sparse shrubland with short graminoids

<u>WEST</u>
Artemisia cana Sparse Shrubland Alliance

V.B.2.d Cold-deciduous saturated sparse shrubland with medium tall graminoids (e.g., shrub/herb fen)

<u>EAST</u>
Alnus serrulata/*Sanguisorba canadense* Sparse Shrubland Alliance
Chamaedaphne calyculata-Carex lasiocarpa Sparse shrubland Alliance
Pentaphylloides floribunda-Carex (*flava*, *interior*, *sterilis*, *lasiocarpa*) Sparse Shrubland Alliance
Physocarpus opulifolius-Calamagrostis canadensis Sparse Shrubland Alliance

<u>SOUTHEAST</u>
Alnus serrulata/*Carex crinita* Sparse Shrubland Alliance

<u>MIDWEST</u>
Alnus serrulata/*Carex crinita* Sparse Shrubland Alliance
Pentaphylloides floribunda-Carex spp. Sparse Shrubland Alliance
Salix petiolaris-Carex spp. Sparse Shrubland Alliance

V.B.2.* Cold-deciduous saturated sparse shrubland with tall graminoids

<u>SOUTHEAST</u>
Myrica cerifera Sparse Wetland Shrubland Alliance
Physocarpus opulifolius/*Calamagrostis canadensis* Sparse Shrubland Alliance

V.B.3 COLD-DECIDUOUS SPARSE SHRUBLAND WITH A SPARSELY VEGETATED GROUND LAYER

V.B.3.a Cold-deciduous sparse shrubland on rocky substrate

<u>EAST</u>
Kalmia latifolia-Schizachyrium scoparium-Helianthemum bicknellii Sparse shrubland Alliance

V.B.4 EXTREMELY XEROMOROPHIC EVERGREEN SPARSE SHRUBLAND (LOWER STRATA UNDEFINED)

V.C. *MIXED EVERGREEN-DECIDUOUS SPARSE SHRUBLAND (SCRUB)*

V.C.1 MIXED EVERGREEN - DROUGHT-DECIDUOUS SPARSE SHRUBLAND WITH A DOMINANT HERBACEOUS STRATUM

V.C.2 BROAD-LEAVED SEMI-EVERGREEN SPARSE SHRUBLAND WITH A

DOMINANT HERBACEOUS STRATUM

V.C.2.a Broad-leaved semi-evergreen sparse shrubland with tall graminoids

V.C.2.b Broad-leaved semi-evergreen sparse shrubland with medium tall graminoids

V.C.2.c Broad-leaved semi-evergreen sparse shrubland with short graminoids

<u>WEST</u>

Chrysothamnus nauseosus Sparse Shrubland Alliance

V.C.3 EXTREMELY XEROMORPHIC MIXED EVERGREEN - DECIDUOUS SPARSE SHRUBLAND

VI. **DWARF SHRUBLAND (DWARF-SCRUB)**

VI.A. *EVERGREEN DWARF SHRUBLAND (DWARF-SCRUB)*

VI.A.1 NEEDLE-LEAVED AND MICROPHYLLOUS EVERGREEN DWARF-SHRUBLAND

VI.A.1.a Needle-leaved and microphyllous evergreen caespitose dwarf-shrubland (e.g., alpine azalea)

<u>WEST</u>

Ambrosia dumosa Dwarf-Shrubland Alliance

VI.A.1.b Needle-leaved and microphyllous evergreen creeping or matted dwarf-shrubland

<u>EAST</u>

Hudsonia (*tomentosa*, *ericoides*) Dwarf Shrubland Alliance

<u>MIDWEST</u>

Juniperus horizontalis Dwarf-Shrubland Alliance

<u>WEST</u>

Arctostaphylos uva-ursi Dwarf-Shrubland Alliance

Juniperus horizontalis Dwarf-Shrubland Alliance

VI.A.1.c Needle-leaved and microphyllous evergreen cushion dwarf-shrubland

<u>WEST</u>

Cassiope mertensiana Dwarf-Shrubland Alliance

Empetrum nigrum Dwarf-Shrubland Alliance

Eriogonum ovalifolium var. *depressum* Dwarf-Shrubland Alliance

Phyllodoce empetriformis Dwarf-Shrubland Alliance
Phyllodoce glanduliflora Dwarf-Shrubland Alliance

VI.A.1.d Needle-leaved and microphyllous evergreen caespitose saturated dwarf-shrubland (e.g., dwarf shrub bogs)

MIDWEST
Chamaedaphne calyculata-Andromeda glaucophylla Dwarf-Shrubland Alliance

VI.A.1.e Needle-leaved and microphyllous evergreen creeping or matted saturated dwarf-shrubland

VI.A.1.* Needle-leaved and microphyllous evergreen cushion saturated dwarf-shrubland

WEST
Kalmia microphylla Dwarf-Shrubland Alliance

VI.A.1.* Broad-leaved evergreen dwarf shrubland

VI.A.1.* Broad-leaved evergreen saturated dwarf shrubland

EAST
Chamaedaphne calyculata Dwarf Shrub Alliance

VI.A.2 EXTREMELY XEROMORPHIC EVERGREEN DWARF-SHRUBLAND
VI.A.2.a Evergreen subdesert dwarf-shrubland

WEST
Artemisia pygmaea Dwarf-Shrubland Alliance

VI.B. *DECIDUOUS DWARF-SHRUBLAND*
VI.B.1 DROUGHT-DECIDUOUS DWARF-SHRUBLAND
VI.B.1.a Drought-deciduous caespitose dwarf-shrubland
VI.B.1.b Drought-deciduous creeping or matted dwarf-shrubland
VI.B.1.c Drought-deciduous cushion dwarf-shrubland

VI.B.2 COLD-DECIDUOUS DWARF-SHRUBLAND
VI.B.2.a Cold-deciduous caespitose dwarf-shrubland
(*Diapensia lapponica* dwarf-shrubland see *Carex bigelowii-Juncus trifidus* Herbaceous Alliance)

Vaccinium (*myrtilloides, vacillans, angustifolium*) Dwarf-Shrubland Alliance

<u>WEST</u>
Baccharis pilularis Dwarf-Shrubland Alliance
Vaccinium deliciosum Dwarf-Shrubland Alliance
Vaccinium membranaceum Dwarf-Shrubland Alliance

VI.B.2.b Cold-deciduous creeping or matted dwarf-shrubland

<u>WEST</u>
Salix arctica Dwarf-Shrubland Alliance
Salix cascadensis Dwarf-Shrubland Alliance
Salix nivalis Dwarf-Shrubland Alliance
Salix reticulata Dwarf-Shrubland Alliance

VI.B.2.c Cold-deciduous cushion dwarf-shrubland
VI.B.2.d Cold-deciduous saturated dwarf-shrubland

<u>EAST</u>
Gaylussacia baccata (*dumosa*) Dwarf-Shrubland Alliance
Vaccinium macrocarpon Dwarf-Shrubland Alliance
Vaccinium uliginosum Dwarf-Shrubland Alliance

VI.B.3 EXTREMELY XEROMORPHIC DECIDUOUS DWARF-SHRUBLAND
VI.B.3.a Deciduous subdesert dwarf-shrubland without succulents

<u>WEST</u>
Artemisia pedatifida Dwarf-Shrubland Alliance
Artemisia spinescens Dwarf-Shrubland Alliance
Salvia dorrii Dwarf-Shrubland Alliance

VI.C *MIXED EVERGREEN-DECIDUOUS DWARF-SHRUBLAND (DWARF SCRUB)*
VI.C.1 MIXED EVERGREEN - DROUGHT-DECIDUOUS DWARF-SHRUBLAND
VI.C.1.a Facultatively drought-deciduous dwarf-shrubland
VI.C.1.b Mixed evergreen - cold-deciduous dwarf-shrubland

VI.C.2 MIXED EVERGREEN- COLD-DECIDUOUS DWARF-SHRUBLAND
VI.C.2.a Mixed evergreen - cold-deciduous dwarf-shrubland

VI.C.3 EXTREMELY XEROMORPHIC MIXED EVERGREEN - DECIDUOUS

DWARF-SHRUBLAND
VI.C.3.a Deciduous subdesert dwarf-shrubland with succulents
VI.C.3.b Facultatively deciduous subdesert dwarf-shrubland

WEST
Atriplex corrugata Dwarf-Shrubland Alliance
Atriplex gardneri Dwarf-Shrubland Alliance
Atriplex obovata Dwarf-Shrubland Alliance
Eriogonum sphaerocephalum Dwarf-Shrubland Alliance
Eriogonum thymoides Dwarf-Shrubland Alliance

VI.C.3.c Mixed evergreen - deciduous subdesert shrubland
VI.A.3.* Microphyllous evergreen saturated dwarf-shrubland

EAST
Empetrum nigrum Dwarf Shrub Alliance

VII. **SPARSE DWARF-SHRUBLAND (SPARSE DWARF-SCRUB)**
VII.A. *EVERGREEN SPARSE DWARF-SHRUBLAND (SPARSE DWARF-SHRUB)*
VII.A.1 NEEDLE-LEAVED AND MICROPHYLLOUS EVERGREEN SPARSE DWARF-SHRUBLAND WITH A DOMINANT HERBACEOUS STRATUM
VII.A.1.a Needle-leaved or microphyllous evergreen sparse dwarf-shrubland with medium tall graminoids

WEST
Artemisia arbuscula Sparse Dwarf-Shrubland Alliance
Artemisia longiloba Sparse Dwarf-Shrubland Alliance
Artemisia nova Sparse Dwarf-Shrubland Alliance
Artemisia pedatifida Sparse Dwarf-Shrubland Alliance
Artemisia rigida Sparse Dwarf-Shrubland Alliance

VII.A.1.b Needle-leaved or microphyllous evergreen sparse dwarf-shrubland with short bunch graminoids (e.g., Puna of Oruru Bolivia)
VII.A.1.c Temperate or subpolar alpine and subalpine needle-leaved or microphyllous evergreen sparse dwarf-shrub meadows
VII.A.1.d Needle-leaved or microphyllous evergreen seasonally flooded/saturated sparse dwarf-shrubland with short bunch graminoids (e.g., mixed shrub/sedge tussock tundra)

VII.A.2 NEEDLE-LEAVED AND MICROPHYLLOUS EVERGREEN SPARSE

DWARF-SHRUBLAND WITH A DOMINANT NON-VASCULAR STRATUM

VII.A.2.a Needle-leaved or microphyllous evergreen caespitose saturated sparse dwarf-shrubland

VII.A.2.b Needle-leaved or microphyllous evergreen creeping or matted saturated sparse dwarf-shrubland

VII.A.2.c Needle-leaved or microphyllous sparse dwarf-shrubland with lichens (wetland?)

VII.A.3 NEEDLE-LEAVED AND MICROPHYLLOUS EVERGREEN SPARSE DWARF-SHRUBLAND WITH A SPARSELY VEGETATED STRATUM

VII.A.3.a Needle-leaved or microphyllous evergreen sparse dwarf-shrubland with rocky cover (e.g., alpine)

VII.A.3.b Needle-leaved or microphyllous evergreen intermittently flooded sparse dwarf-shrubland on semi-arid alluvial substrate

VII.A.* Broad-leaved evergreen sparse dwarf-shrubland with a dominant herbaceous stratum

VII.A.*. Broad-leaved evergreen sparse dwarf shrubland with medium-tall graminoids

SOUTHEAST

Sibbaldiopsis tridentata/*Danthonia compressa* Sparse Dwarf Shrubland Alliance

VII.B. *DECIDUOUS SPARSE DWARF-SHRUBLAND (SPARSE DWARF-SCRUB)*

VII.B.1 DROUGHT-DECIDUOUS SPARSE DWARF-SHRUBLAND WITH A DOMINANT HERBACEOUS STRATUM

VII.B.1.a Drought deciduous sparse dwarf-shrubland with medium tall graminoids (e.g., Artemisia pedatafida)

VII.B.2 COLD-DECIDUOUS SPARSE DWARF-SHRUBLAND WITH A DOMINANT HERBACEOUS STRATUM

VII.B.2.a Cold-deciduous seasonally flooded/saturated sparse dwarf-shrubland with graminoids (height?) (e.g., sedge tundra)

VII.B.3 EXTREMELY XEROMORPHIC DECIDUOUS SPARSE DWARF-SHRUBLAND (LOWER STRATA UNDEFINED)

VII.C. *MIXED EVERGREEN - DECIDUOUS SPARSE DWARF-SHRUBLAND (SCRUB)*

VII.C.1 MIXED EVERGREEN - DROUGHT-DECIDUOUS SPARSE DWARF-SHRUBLAND WITH A DOMINANT HERBACEOUS STRATUM

VII.C.1.a Facultatively drought-deciduous sparse dwarf-shrubland

(herbaceous strata undefined)

VII.C.2 MIXED EVERGREEN - COLD-DECIDUOUS SPARSE DWARF-SHRUBLAND WITH A DOMINANT HERBACEOUS STRATUM

VIII. **HERBACEOUS**

VIII.A. *TALL GRASSLAND (GRAMINOIDS)*

VIII.A.1 TROPICAL AND SUBTROPICAL TALL GRASSLAND (graminoids can be >2m)

VIII.A.1.a Tropical and subtropical tall grassland

VIII.A.1.b Tropical and subtropical seasonally flooded tall grassland

VIII.A.1.c Tropical and subtropical semipermanently flooded tall grassland (e.g., Everglades)

SOUTHEAST

Cladium mariscus ssp. *jamaicense* Herbaceous Alliance

VIII.A.2 TEMPERATE (AND SUBPOLAR?) TALL GRASSLAND

VIII.A.2.a Dense tall grassland (>60% cover) (including sod or mixed sod-bunch graminoids; e.g., tallgrass prairie)

EAST

Andropogon geradii-Sorgastrum nutans Herbaceous Alliance

SOUTHEAST

Andropogon gerardii-Sorghastrum nutans Herbaceous Alliance
Andropogon gerardii-Panicum virgatum Herbaceous Alliance
Schizachyrium scoparium-Andropogon glomeratus Herbaceous Alliance
Schizachyrium scoparium-Sorghastrum nutans Herbaceous Alliance
Sporobolus silveanus Herbaceous Alliance
Tripsacum dactyloides-Panicum virgatum Upland Herbaceous Alliance

MIDWEST

Andropogon gerardii-Panicum virgatum Herbaceous Alliance
Andropogon gerardii-(*Sorghastrum nutans*) Herbaceous Alliance
Andropogon hallii Herbaceous Alliance
Calamovilfa longifolia Herbaceous Alliance
Schizachyrium scoparium-Sorghastrum nutans Herbaceous Alliance

WEST

Andropogon gerardii-(*Sorghastrum nutans*) Herbaceous Alliance
Andropogon hallii Herbaceous Alliance
Calamovilfa longifolia Herbaceous Alliance

VIII.A.2.b Open tall grassland (<60% cover)
(including sod or mixed sod-bunch graminoids)
VIII.A.2.c Tall bunch grassland

WEST
Leymus cinereus Herbaceous Alliance
Panicum virgatum Herbaceous Alliance
Sporobolus wrightii Herbaceous Alliance

VIII.A.2.d Seasonally/temporarily flooded tall grassland (e.g., low prairie, meadow)

EAST
Calamagrostis canadensis-Phalaris arundinacea Herbaceous Alliance
Juncus balticus Herbaceous Alliance

SOUTHEAST
Carex trichocarpa-Lysimachia quadriflora-Lythrum alatum Herbaceous Alliance
Carex walteriana Seasonally/temporarily Flooded Herbaceous Alliance
Panicum hemitomon Herbaceous Alliance
Spartina pectinata Herbaceous Alliance

MIDWEST
Calamagrostis spp.- *Carex* spp. Herbaceous Alliance
Carex lacustris-Carex atherodes Herbaceous Alliance
Cyperus spp. Herbaceous Alliance?
Phalaris arundinacea Herbaceous Alliance
Polygonus spp.-*Echinochloa* spp.-*Distichlis stricta* Herbaceous Alliance
Scirpus spp.-*Typha* spp.-*Juncus* spp. Herbaceous Alliance
Spartina pectinata-Carex spp.-*Calamagrostis* spp. Herbaceous Alliance

WEST
Phalaris arundinacea Herbaceous Alliance
Phragmites australis Herbaceous Alliance
Spartina pectinata Herbaceous Alliance

VIII.A.2.e Semipermanently flooded tall grassland (e.g., cattail marsh)

EAST
Typha latifolia Herbaceous Alliance
Scirpus spp. Herbaceous Alliance
Scirpus (*robustus*/*maritimus*) Herbaceous Alliance

SOUTHEAST
Phragmites australis Herbaceous Alliance
Scirpus spp.-*Typha* spp.-*Sparganium* spp.-*Juncus* spp. Herbaceous Alliance
Typha latifolia Herbaceous Alliance

MIDWEST
Phragmites australis Herbaceous Alliance
Scirpus acutus-S. validus Herbaceous Alliance
Scirpus maritimus-S. acutus-S. fluviatilis Herbaceous Alliance
Scirpus spp.-*Typha* spp.-*Sparganium* spp.-*Juncus* spp. Herbaceous Alliance
Typha spp. Herbaceous Alliance
Zizania spp. (*aquatica, palustris*) Herbaceous Alliance

VIII.A.2.f Saturated tall grassland

SOUTHEAST
Carex interior-Carex lurida Herbaceous Alliance
Carex walteriana Saturated Herbaceous Alliance
Ctenium aromaticum-Muhlenbergia capillaris var. *trichopodes* Herbaceous Alliance

MIDWEST
Andropogon gerardii-Carex spp. Herbaceous Alliance
Calamagrostis canadensis-Carex Wide-Leaved spp. (*lacustris-stricta*) Herbaceous Alliance
Typha spp. Herbaceous Alliance

VIII.A.2 g Brackish-tidal regularly flooded tall grassland

EAST
Typha angustifolia-Hibiscus palustris Herbaceous Alliance
Spartina cynosuroides Herbaceous Alliance
Phragmites australis Herbaceous Alliance
Spartina alterniflora-Lilaeopsis chinensis Herbaceous Alliance

VIII.A.2.h Freshwater-tidal regularly flooded tall grassland

EAST
Zizania aquatica Herbaceous Alliance

VIII.A.2.i Saltwater-tidal regularly flooded tall grassland (e.g., big cordgrass marsh)

EAST
Spartina alterniflora Herbaceous Alliance

SOUTHEAST
Juncus roemerianus Saline Herbaceous Alliance
Spartina alterniflora Herbaceous Alliance

VIII.A.2.* Brackish-tidal irregularly flooded tall grassland

SOUTHEAST
Juncus roemerianus Brackish/Intermediate Herbaceous Alliance
Spartina patens-Juncus roemerianus Brackish Herbaceous Alliance

VIII.B. *MEDIUM TALL GRASSLAND* (graminoids)
VIII.B.1 TROPICAL AND SUBTROPICAL MEDIUM TALL GRASSLAND

VIII.B.2 TEMPERATE AND SUBPOLAR MEDIUM TALL GRASSLAND
VIII.B.2.a Dense medium tall grassland (>60% cover) (including sod or mixed sod-bunch graminoids; e.g., mixedgrass prairie)

MIDWEST
Elymus lanceolatus (*Agropyron dasystachyum*)-*Koeleria macrantha* Herbaceous Alliance
Festuca scabrella Herbaceous Alliance
Muhlenbergia cuspidata Herbaceous Alliance?
Pascopyrum (*Agropyron*) *Smithii-Stipa comata* Herbaceous Alliance
Poa spp.-*Sporobolus* spp. Montane Herbaceous Alliance?
Schizachyrium scoparium-Boutelous curtipendula Herbaceous Alliance
Schizachyrium scoparium-Sporobolus cryptandrus-Cyperus schweinitzii Herbaceous Alliance
Sporobolus heterolepis Herbaceous Alliance
Stipa comata-Bouteloua gracilis Herbaceous Alliance

Stipa curtiseta-Elymus lanceolatus (*Agropyron dasystachyum*) Herbaceous Alliance

VIII.B.2.b Open medium tall grassland (<60% cover) (including sod or mixed sod-bunch graminoids; e.g., glades and dune grasslands)

<u>EAST</u>
Dactylis glomerata-Rumex acetosella Herbaceous Alliance
Danthonia compressa Herbaceous Alliance
Ammophila breviligulata Herbaceous Alliance

<u>SOUTHEAST</u>
Schizachyrium scoparium-(*Aristida* spp.) Herbaceous Alliance
Schizachyrium scoparium-Bouteloua curtipendula Herbaceous Alliance
Schizachyrium scoparium-Sporobolus (*asper-heterolepis*) Herbaceous Alliance
Sporobolus flexuosus Herbaceous Alliance

<u>MIDWEST</u>
Schizachurium scoparium-(*Aristida* spp.) Herbaceous Alliance
Schizachyrium scoparium-Bouteloua curtipendula-(*Ophioglossum engelmannii*) Herbaceous Alliance

<u>WEST</u>
Agrostis stolonifera Herbaceous Alliance
Calamagrostis canadensis Herbaceous Alliance
Elymus glaucus Herbaceous Alliance
Elymus hirsutus Herbaceous Alliance
Festuca rubra Herbaceous Alliance
Glyceria borealis Herbaceous Alliance
Panicum obtusum Herbaceous Alliance
Pascopyrum smithii Herbaceous Alliance

VIII.B.2.c Medium tall bunch grassland

<u>WEST</u>
Aristida longiseta Herbaceous Alliance
Bouteloua curtipendula Herbaceous Alliance
Carex hoodii Herbaceous Alliance
Danthonia californica Herbaceous Alliance
Festuca arizonica Herbaceous Alliance

Festuca idahoensis Herbaceous Alliance
Festuca scabrella Herbaceous Alliance
Festuca thurberi Herbaceous Alliance
Festuca viridula Herbaceous Alliance
Hilaria mutica Herbaceous Alliance
Leymus ambiguus Herbaceous Alliance
Muhlenbergia emersleyi Herbaceous Alliance
Muhlenbergia montana Herbaceous Alliance
Oryzopsis hymenoides Herbaceous Alliance
Panicum bulbosum Herbaceous Alliance
Poa cusickii Herbaceous Alliance
Poa nervosa Herbaceous Alliance
Poa nevadensis Herbaceous Alliance
Poa palustris Herbaceous Alliance
Pseudoroegneria spicata Herbaceous Alliance
Schizachurium scoparium Herbaceous Alliance
Sporobolus airoides Herbaceous Alliance
Sporobolus flexuosus Herbaceous Alliance
Sporobolus nealleyi Herbaceous Alliance
Stipa comata Herbaceous Alliance
Stipa nelsonii Herbaceous Alliance
Stipa neomexicana Herbaceous Alliance
Stipa richardsonii Herbaceous Alliance
Stipa viridula Herbaceous Alliance

VIII.B.2.d Seasonally/temporarily flooded medium tall grassland

EAST
Carex striata Herbaceous Alliance
Carex stricta Herbaceous Alliance
Cladium mariscoides Herbaceous Alliance
Deschampsia cespitosa Herbaceous Alliance
Dulichium arundinaceum Herbaceous Alliance
Rhynchospora macrostachya Herbaceous Alliance
Sporobolus heterolepis-Eleocharis compressa Herbaceous Alliance

SOUTHEAST
Carex torta Herbaceous Alliance

MIDWEST

Carex stricta-Carex spp. (*aquatilis,rostrata*) Herbaceous Alliance
Eleocharis melanocarpa-Rhynchospora macrostachya Herbaceous Alliance
Distichlis spicata-(*Hordeum jubatum*) Herbaceous Alliance
Salicornia rubra Herbaceous Alliance
Scirpus maritimus Herbaceous Alliance

WEST
Agrostis scabra Herbaceous Alliance
Deschampsia cespitosa Herbaceous Alliance
Leymus triticoides Herbaceous Alliance
Panicum bulbosum Herbaceous Wetland Alliance
Spartina gracilis Herbaceous Alliance
Sporobolus airoides Wetland Herbaceous Alliance
Sporobolus flexuosus Wetland Herbaceous Alliance

VIII.B.2.e Semipermanently flooded medium tall grassland (e.g., sedge meadows)

MIDWEST
Carex crinita-Osmunda spp.-*Sphagnum* spp. Herbaceous Alliance
Carex interior-Carex lurida Herbaceous Alliance?
Carex lanuginosa-(*C. nebrascensis*)-*Scirpus* spp. Herbaceous Alliance
Carex oligosperma-C. lasiocarpa Herbaceous Alliance

WEST
Carex rostrata Herbaceous Alliance
Scirpus americanus Herbaceous Alliance
Scirpus pungens Herbaceous Alliance

VIII.B.2.f Saturated medium tall grassland (e.g., fens, seeps)

SOUTHEAST
Cladium mariscoides Herbaceous Alliance
Rhynchospora gracilenta Herbaceous Alliance

VIII.B.2.g Saltwater-tidal regularly flooded medium tall grasslands
(e.g., saltwater cordgrass)

EAST
Panicum virgatum Herbaceous Alliance

VIII.B.2.h Brackish-tidal regularly flooded medium tall grassland (e.g., black needle rush)

VIII.B.3 POLAR MEDIUM TALL GRASSLAND
VIII.B.3.a Saturated medium tall grassland with non-vascular plants (e.g., sedge/moss tundra)

VIII.C. *SHORT GRASSLAND (GRAMINOIDS)*
VIII.C.1 TROPICAL AND SUBTROPICAL SHORT GRASSLAND
VIII.C.1.a Tropical alpine short bunch grassland (e.g., Super-paramo)
VIII.C.1.b Tropical or subtropical (wetland) short grassland

VIII.C.2 TEMPERATE AND SUBPOLAR SHORT GRASSLAND
VIII.C.2.a Dense short grassland (>60% cover) (including sod or mixed sod-bunch graminoids, e.g., short grass prairie)

<u>MIDWEST</u>
Bouteloua gracilis-Buchloe dactyloides Herbaceous Alliance

VIII.C.2.b Open short grassland (<60% cover) (including sod or mixed sod-bunch graminoids)

<u>WEST</u>
(*Agropyron caninum*)-*Festuca rubra*-(*Koeleria macrantha*) Herbaceous Alliance
Agropyron dasystachyum Herbaceous Alliance
Bouteloua eriopoda Herbaceous Alliance
Bouteloua gracilis Herbaceous Alliance
Bouteloua hirsuta Herbaceous Alliance
Carex douglasii Herbaceous Alliance
Hilaria jamesii Herbaceous Alliance
Muhlenbergia filiculmis Herbaceous Alliance
Poa secunda Herbaceous Alliance

VIII.C.2.c Short bunch grassland

<u>WEST</u>
Carex straminiformis Herbaceous Alliance
Danthonia intermedia Herbaceous Alliance
Danthonia parryi Herbaceous Alliance
Puccinellia nuttalliana Herbaceous Alliance
Stipa lemmonii Herbaceous Alliance

VIII.C.2.d Alpine and subalpine meadows rich in forbs

WEST
Carex aperta Herbaceous Alliance
Carex aquatilis Herbaceous Alliance
Carex breweri Herbaceous Alliance
Carex buxbaumii Herbaceous Alliance
Carex capitata Herbaceous Alliance
Festuca ovina Herbaceous Alliance

VIII.C.2.e Saltwater-tidal irregularly flooded short grassland (e.g., salt meadows)

EAST
Spartina patens Herbaceous Alliance

VIII.C.2.* Alpine and subalpine short grassland

EAST
Carex bigelowii-Juncus trifidus Alliance
Scirpus cespitosus Herbaceous Alliance

VIII.C.2.* Saturated short grassland

WEST
Carex microptera Herbaceous Alliance
Carex saxatilis Herbaceous Alliance
Distichlis spicata var. *stricta*-(*Hordeum jubatum*) Herbaceous Alliance
Hordeum jubatum Herbaceous Alliance
Muhlenbergia asperifolia Herbaceous Alliance

VIII.C.3 POLAR SHORT GRASSLAND
VIII.C.3.a Polar dense short grassland (>60% cover) (including sod or mixed sod-bunch grassland; e.g., spd grass tundra)
VIII.C.3.b Polar short bunch grassland (e.g. Eriophorum tussok tundra)
VIII.C.3.c Polar seasonally flooded/saturated dense short grassland
VIII.C.3.d Polar seasonally flooded/saturated short bunch grassland

VIII.D. *TALL FORB VEGETATION*
VIII.D.1 PERENNIAL TALL FORB VEGETATION (dominated by perennial plants)
VIII.D.1.a Perennial tall forb vegetation (e.g., tall forb meadows, Utah mountains)

MIDWEST
Pteridiub aquilinum-Bromus kalmii Herbaceous Alliance

VIII.D.1.b Tall fern thickets
VIII.D.1.c Semipermanently flooded perennial tall forb vegetation

MIDWEST
Justicia americana Herbaceous Alliance??
Temporary Pond

VIII.D.1.d Saturated perennial tall forb vegetation

MIDWEST
Symplocarpus foetidus-Caltha palustris Herbaceous Alliance

VIII.D.1.e Saltwater-tidal semipermanently flooded perennial tall forb vegetation
VIII.D.2 ANNUAL TALL FORB VEGETATION
(DOMINATED BY ANNUAL SPECIES)

VIII.E. *LOW FORB VEGETATION*
VIII.E.1 PERENNIAL LOW FORB VEGETATION (dominated by perennial plans)
VIII.E.1.a Perennial low forb vegetation (e.g., Aleutian forb meadows)

EAST
Phlox subulata-Solidago simplex Herbaceous Alliance

SOUTHEAST
Bigelowia nuttallii Herbaceous Alliance

VIII.E.1.b Saltwater-tidal semipermanently flooded perennial low forb vegetation (e.g., Salicornia saltpan)
VIII.E.1.c Seasonally flooded perennial low forb vegetation (e.g., pond shores)
VIII.E.1.* Freshwater tidal regularly flooded perennial forb vegetation

EAST
Pontederia cordata-Peltandra virginica Herbaceous Alliance
Eriocaulon parkeri Herbaceous Alliance

VIII.E.1.* Saltwater tidal regularly/irregularly flooded low perennial forb vegetation

EAST
Salicornia-Spartina alterniflora (short form) Herbaceous Alliance
Cakile edentula Herbaceous Alliance

VIII.E.1.* Brackish tidal regularly/irregularly flooded low perennial forb vegetation

EAST
Amaranthus cannabinus Herbaceous Alliance

VIII.E.1.* Saturated perennial short forb vegetation

SOUTHEAST
Vittaria appalachiana Herbaceous Alliance

VIII.E.2. ANNUAL LOW FORB VEGETATION (dominated by annual species)
VIII.E.2.a Tropical and subtropical ephemeral annual low forb vegetation
VIII.E.2.b Desert or subdesert ephemeral or episodic annual low forb vegetation
VIII.E.2.c Intermittently exposed annual low forb vegetation

VIII.E.2.* Seasonally flooded annual low forb vegetation

EAST
Gratiola aurea-Rhexia virginica Herbaceous Alliance
Eleocharis robbinsii-Proserpinaca pectinata Herbaceous Alliance
Tofieldia glutinosa-Spiranthes spp. Herbaceous Alliance
Chysosplenium americanum-Nasturtium officinale Herbaceous Alliance

VIII.F. *HYDROMORPHIC ROOTED VEGETATION*
VIII.F.1 TROPICAL AND SUBTROPICAL HYDROMORPHIC ROOTED VEGETATION WITHOUT SEASONAL CONTRASTS

VIII.F.2.* Freshwater hydromorphic rooted vegetation

EAST
Nuphar lutea Herbaceous Alliance
Potamogeton perfoliatus-Vallisneria americana Herbaceous Alliance

VIII.F.2.* Tidal saltwater (polyhaline) permanently flooded hydromorphic vegetation

EAST
Zostera marina Herbaceous Alliance
Ruppia maritima Herbaceous Alliance
Potamogeton pectinatus-Zannichellia palustris Herbaceous Alliance

VIII.F.2 TEMPERATE, SUBPOLAR AND POLAR HYDROMORPHIC ROOTED VEGETATION WITH SEASONAL CONTRASTS

MIDWEST
Nelumbo spp.-*Nymphaea* spp. Herbaceous Alliance
Potamoegton spp.-*Ceratophyllum* spp.-*Elodea* spp. Herbaceous Alliance
Ruppia maritima Herbaceous Alliance
Vallisneria americana Herbaceous Alliance?

VIII.F.2.x. Temperate hydromorphic rooted vegetation with sesonal contrasts

SOUTHEAST
Eichhornia crasipes Herbaceous Alliance

IX. **SPARSELY VEGETATED/NON-VASCULAR**
IX.A. *SPARSELY VEGETATED CONSOLIDATED ROCKS (cliff and pavement)*
IX.A.1 SPARSELY VEGETATED CLIFFS
IX.A.1.a Cliffs with chasmophytic vegetation. Plant rooting in fissures of rocks or walls
IX.A.1.b Cliffs with adnate Bromeliaceae (neotropical)
IX.A.1.c Cliffs with sparse to dense non-vascular mats

MIDWEST
Open Bluff/Cliff
Rock Outcrop
Shaded Inland Bluff/Cliff
Wet Cliff

IX.A.2 SPARSELY VEGETATED PAVEMENT
IX.A.2.a Pavement with chasmophytic vegetation in fissures of rock
IX.A.2.b Pavement with sparse to dense non-vascular mats

MIDWEST
Open Pavement

IX.B. *SPARSELY VEGETATED GRAVEL, COBBLE, ROCKS*
IX.B.1 COBBLE/GRAVEL ROCKS
IX.B.1.a Cobble/gravel beach

MIDWEST
Cobble/Gravel Shore
Gravel Wash

IX.B.1.b Cobble/gravel pavement

IX.C. *SPARSELY VEGETATED SCREES AND TALUS*
IX.C.1 SPARSELY VEGETATED SCREES
IX.C.1.a Lowland and submontane scree

WEST
Artemisia tridentata Sparsely Vegetated Alliance

IX.C.1.b Montane scree

WEST
Abies concolor Sparsely Vegetated Alliance
Pinus contorta Sparsely Vegetated Alliance
Pinus flexilis Sparsely Vegetated Alliance
Pinus ponderosa Sparsely Vegetated Alliance
Populus tremuloides Sparsely Vegetated Alliance
Pseudotsuga menziesii Sparsely Vegetated Alliance

IX.C.1.c High mountain scree

WEST
Abies lasiocarpa Sparsely Vegetated Alliance
Picea engelmannii Sparsely Vegetated Alliance
Pinus aristata Sparsely Vegetated Alliance
Rubus idaeus var. *sachalinensis* Sparsely Vegetated Alliance

IX.C.2 SPARSELY VEGETATED TALUS
IX.C.2.a Lowland and submontane talus
IX.C.2.b Mountain talus

WEST

Carex foenea Sparsely Vegetated Alliance
Ribes montigenum Sparsely Vegetated Alliance

IX.D. *SPARSELY VEGETATED SAND ACCUMULATIONS*
IX.D.1 SPARSELY VEGETATED SAND DUNES
IX.D.1.a Tall-grass dune

MIDWEST
Ammophila breviligulata Sparsely Vegetated Alliance

IX.D.1.b Short-grass dune

WEST
Elymus mollis-Poa macrantha Sparsely Vegetated Alliance
Festuca rubra Sparsely Vegetated Alliance

IX.D.1.c Forb dune (possibily existing)

MIDWEST
Cakile Edentula Sparsely Vegetated Alliance
Inland Strand Beach

IX.D.1.d Shrub dune

WEST
Ambrosia dumosa Sparsely Vegetated Alliance
Sarcobatus vermiculatus Sparsely Vegetated Alliance

IX.D.1.* Medium tall grass dune

WEST
Elymus flavescens Sparsely Vegetated Alliance
Juncus falcatus Sparsely Vegetated Alliance
Oryzopsis hymenoides Sparsely Vegetated Dune Alliance
Schizachurium scoparium var. *neomexicanum* Sparsely Vegetated Alliance

IX.D.2 BARE SAND DUNES
IX.D.2.a Shifting dunes in desert climate
IX.D.2.b Shifting dunes in forest climate

IX.D.3 SAND FLATS

MIDWEST
Sand Flat

IX.E. *TRUE DESERTS (vegetation largely absent)*

IX.F. *SPARSELY VEGETATED MUD FLATS AND ERODING SLOPES*
IX.F.1 SPARSELY VEGETATED MUD FLATS
IX.F.1.a (wetland, non-tidal) mud flat

MIDWEST
Mud Flat

IX.F.1.b Saltwater-tidal regularly flooded mud flat
IX.F.1.c Brackish-tidal regularly flooded mud flat
IX.F.1.d Freshwater-tidal regularly flooded mud flat

IX.F.2 ERODING SLOPES
IX.F.2.a Lake/river bluff eroding slope

MIDWEST
Small Eroding Cliffs/Banks
Eroding Clay Slopes

IX.F.2.b Large eroding slope (e.g., Badlands)

MIDWEST
Large Eroding Cliffs

WEST
Oryzopsis hymenoides Sparsely Vegetated Alliance

X.A.1.* Cliffs with chasmophytic vegetation--Plants rooting in fissures of rocks or walls

SOUTHEAST
Celtis tenuifolia-Rhus aromatica Sparsely Vegetated/Nonvascular Alliance
Sedum nuttallianum Sparsely Vegetated/Nonvascular Alliance

X.D.3.* Saltwater tidal irregularly flooded sand flats

SOUTHEAST
Salicornia bigelovii-Salicornia virginica Sparsely Vegetated/Nonvascular Alliance

APPENDIX 11.2 Examples of Community Descriptions

***Quercus alba-Carya ovata*/(*Ostrya virginiana*) Forest**

COMMON NAME White oak-Shagbark hickory/(Ironwood) Forest

SYNONYM White oak-Hickory Forest

TNC SYSTEM Terrestrial

PHYSIOGNOMIC CLASS Forest

PHYSIOGNOMIC SUBCLASS Deciduous forest

FORMATION GROUP Cold-deciduous forest

FORMATION Lowland and submontane broad-leaved cold-deciduous forest

ALLIANCE *Quercus alba-Quercus rubra*-(*Carya ovata*) Forest

CLASSIFICATION CONFIDENCE LEVEL 2

RANGE
This community is found in E Kansas, SE Nebraska, W Iowa, and N Missouri. In Nebraska, it is most abundant on the bluffs of the Missouri River as far north as Omaha. It occurs on flat uplands in central Iowa and along the lower courses of tributaries of the Missouri River, such as the Nemaha River, Platte River, and Weeping Water Creek. In the extreme SE corner of the state, it may extend as far as 35 km west of the Missouri River on uplands; this distance gradually decreases as one moves north.

ENVIRONMENTAL DESCRIPTION
Quercus alba-(*Carya ovata*)/(*Ostrya virginiana*) Forest occurs on gentle to moderately steep slopes on uplands and on steep valley sides. In Iowa, this type is typically found on flat uplands. This community does not flood or have saturated soils. Soils are silt, clay, or loam, moderately deep to deep, and somewhat poorly drained to well drained. The parent material is loess, glacial till, limestone, shale, or sandstone.

USFWS WETLAND SYSTEM Not applicable.

STRATA	MOST ABUNDANT SPECIES
Tree canopy	*Carya cordiformis*, *Carya ovata*, *Ostrya virginiana*, *Quercus alba*, *Quercus rubra*, *Quercus velutina*, *Tilia americana*
Short shrub	*Ribes* spp., *Symphoricarpos orbiculatus*
Herbaceous	Information not available.

DIAGNOSTIC SPECIES
Carya ovata, *Ostrya virginiana*, *Quercus alba*, *Ribes* spp., *Symphoricarpos orbiculatus*

VEGETATION DESCRIPTION
This is a mesic forest community with a tall deciduous tree canopy and a poorly developed sub-canopy. Short shrub and herbaceous layers are well developed. Short shrub species present in Nebraska communities include *Ribes* spp. and *Symphoricarpos orbiculatus*. Among the herbaceous species present in Nebraska communities are *Aquilegia canadensis*, *Arnoglossum atriplicifolium*, *Caulophyllum thalictroides*, *Dicentra cucullaria*, *Laportea canadensis*, *Smilax tamnoides*, and *Verbena urticifolia*. Near the more xeric bluff tops this community is more open with a great abundance of shrubby plants. In Nebraska, this type is dominated by *Quercus velutina* and *Carya ovata*, and *Quercus alba* is at its western range limit. Weaver (1965) described this type as a *Quercus velutina-Carya ovata* community. In Iowa, the absence of *Carpinus caroliniana* could be used to separate this type from *Quercus alba* dominated stands in e.g. Ledges State Park (Johnson-Groh 1985).

OTHER NOTEWORTHY SPECIES Information not available.

CONSERVATION RANK G2/G3

RANK JUSTIFICATION
Many sites have been cleared or degraded by overgrazing.

COMMENTS
Many eastern oak-hickory forest species reach their northern and western distributional limit in this community type.

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***Pinus banksiana*/*Aronia melanocarpa-Xanthoparmelia* spp. Woodland**

COMMON NAME	Jack pine/Black chokeberry/Lichen Woodland
SYNONYM	Sandstone pavement barren
TNC SYSTEM	Terrestrial
PHYSIOGNOMIC CLASS	Woodland
PHYSIOGNOMIC SUBCLASS	Evergreen woodland
FORMATION GROUP	Needle-leaved evergreen woodland
FORMATION	Needle-leaved evergreen woodland with rounded crowns
ALLIANCE	*Pinus (banksiana, resinosa, ridiga)* Woodland

CLASSIFICATION CONFIDENCE LEVEL 2

RANGE
This community type is known only from the northernmost counties of New York and southern Quebec. Its distribution outside of this range is not well known and similar communities may occur in Ontario, Minnesota and Iowa.

ENVIRONMENTAL DESCRIPTION
The *Pinus banksiana*/*Aronia melanocarpa-Xanthoparmelia* spp. Woodland occurs on very shallow soils over sandstone bedrock. It is best developed where the bedrock forms a nearly level pavement.

USFWS WETLAND SYSTEM Not applicable.

STRATA	MOST ABUNDANT SPECIES
Tree canopy	*Pinus banksiana*
Shrub	*Vaccinium angustifolium, Gaylussacia baccata*
Herbaceous	*Pteridium aquilinum*
Non-vascular	*Xanthoparmelia* spp., *Cladonia* spp.

DIAGNOSTIC SPECIES
Pinus banksiana, *Aronia melanocarpa*, *Vaccinium angustifolium*, *Gaylussacia baccata*, *Pteridium aquilinum*, *Cladonia* spp., *Xanthoparmelia* spp.

VEGETATION DESCRIPTION
The dominant tree is generally *Pinus banksiana*, although *Pinus strobus* or *Pinus resinosa* may be locally dominant at some sites. Other characteristic trees include *Acer rubrum*, *Betula papyrifera*, *Quercus rubra* and *Quercus coccinea*. The shrub layer is dominated by heaths including *Vaccinium angustifolium*, *Gaylussacia baccata*, as well as *Aronia melanocarpa* and *Comptonia peregrina*. The groundcover includes several lichens and mosses which may form a continuous cover in some areas. Characteristic lichens include *Cladonia* spp., *Cladina* spp., *Sterocaulon* sp. and *Xanthoparmelia* sp.; characteristic mosses include *Polytrichum* spp. and *Pleurozium schreberi*. Herbs including *Pteridium aquilinum*, *Gaultheria procumbens*, *Danthonia spicata* and *Deschampsia flexuosa* are scattered throughout.

OTHER NOTEWORTHY SPECIES Information not available.

CONSERVATION RANK G2

RANK JUSTIFICATION
This community type is found in a restricted range and has few occurrences.

COMMENTS
This community is related to jack pine woodlands in Maine and New Hampshire and also to acidic rock outcrop communities throughout New England. Floristically, it is quite depauperate, and its distinctiveness may be partially a function of the lichen flora. Comparable information is not yet available for many similar types.

REFERENCES
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Pinus serotina/*Arundinaria gigantea* Sparse Woodland

COMMON NAME	Pond Pine/Giant Cane Sparse Woodland
SYNONYM	Peatland Canebrake
TNC SYSTEM	Terrestrial
PHYSIOGNOMIC CLASS	Sparse Woodland
PHYSIOGNOMIC SUBCLASS	Evergreen sparse woodland
FORMATION GROUP	Needle-leaved evergreen sparse woodland with a dominant herbaceous stratum
FORMATION	Needle-leaved evergreen sparse wetland woodland with tall graminoids
ALLIANCE	*Pinus serotina*/*Arundinaria gigantea* Sparse Woodland

CLASSIFICATION CONFIDENCE LEVEL 2

RANGE
The potential range of this community is the mid-Atlantic coastal plain from Virginia to South Carolina. Occurrences are known from the coastal plain of North Carolina and Virginia.

ENVIRONMENTAL DESCRIPTION
This community occurs on shallow organic soils 10 cm to 100 cm deep, in areas burned at a frequency of every 3-12 years (Frost 1989). Typically this community is found "around the periphery of deep peat deposits; where peat feathers out onto mineral soil; in peat-filled depressions and sloughs in pine barrens; and on upland flats where drainage is poor enough to permit accumulation of an organic layer thick enough to support the cane rhizome mat" (Frost n. d.). Soils supporting this type are Histosols, especially Terric Medisaprists and shallow Typic Medisaprists, and other soils with histic epipedons such as Umbraquults, Ochraquults and Fluvaquents. It is likely that the soil is saturated throughout most of the winter and spring, and probably dries in the summer and fall. Organic matter depth, fire frequency, and nutrient availability are the primary factors controlling vegetation structure and composition in this community (Frost n. d.)

USFWS WETLAND SYSTEM Palustrine

STRATA	MOST ABUNDANT SPECIES
Tree canopy	*Pinus serotina*
Herbaceous	*Arundinaria gigantea*

DIAGNOSTIC SPECIES
Pinus serotina, *Arundinaria gigantea*, *Smilax laurifolia*, *Rubus hispidus*

VEGETATION DESCRIPTION
This community is characterized by a dense stand of *Arundinaria gigantea* occasionally reaching 9 m to 10 m in height with scattered to fairly dense *Pinus serotina*. Physiognomy and structure vary with time since last burn. In areas that burn every 3 to 5 years the appearance of the community will be that of pure *Arundinaria gigantea* with, perhaps, scattered *Pinus serotina* (Frost 1989). Cover of pocosin shrubs (eg. *Ilex glabra*, *Ilex coriacea*, *Lyonia lucida*, *Lyonia ligustrina*, *Cyrilla racemiflora*, *Zenobia pulverulenta*, *Magnolia virginiana*, *Aronia arbutifolia*) and *Acer rubrum* increase with lack of fire and, with greater than 15 years of fire suppression, these species will overtake the cane.

OTHER NOTEWORTHY SPECIES Information not available.

CONSERVATION RANK G1

RANK JUSTIFICATION
This community is thought to have been common in presettlement times, existing as large, open tracts. Frost (n. d.) estimates that, prior to european settlement, there were no less than 101,170 ha of canebrake in southeastern Virginia alone, and that, as of 1989, less than 800 ha remain in Virginia, North Carolina, and South Carolina. Most of the presettlement acreage has succeeded to pocosin vegetation because of fire exclusion or has been drained and cleared for agriculture.

COMMENTS
This pyrophytic wetland community is dependant on the maintenance of the natural hydrologic and fire regime. Stand height, density and species composition vary with organic matter depth, fire frequency and fertility (Frost 1989). This community may grade into woodlands on mineral soil dominated by *Pinus palustris*, *Pinus serotina*, and/or *Pinus taeda*. On areas of deeper peat, this community grades into forests dominated by *Chamaecyparis thyoides* and into pocosin shrublands.

This community, or one similar to it, may be present in southern Georgia and in Florida (S. Orzell, pers. comm).

REFERENCES

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Sanguisorba canadensis-Parnassia grandifolia-Helenium brevifolium Shrubland

COMMON NAME	American burnet-Big leaved grass of parnassus-Few headed sneezeweed Shrubland
SYNONYM	Oligotrophic saturated scrub
TNC SYSTEM	Terrestrial
PHYSIOGNOMIC CLASS	Shrubland
PHYSIOGNOMIC SUBCLASS	Deciduous shrubland
FORMATION GROUP	Cold-deciduous shrubland
FORMATION	Deciduous seasonally/temporarily flooded shrubland
ALLIANCE	*Alnus serrulata*/*Sanguisorba canadensis* Shrubland

CLASSIFICATION CONFIDENCE LEVEL 2

RANGE
Apparently restricted to western Virginia in Grayson and Carrol counties. A similar type of vegetation occurs on Bluff Mountain in North Carolina.

ENVIRONMENTAL DESCRIPTION
All known occurrences are in seepage areas underlain by hornblende, gabbro or gniessic bedrock at elevations ranging from about 2400 ft. to 3500 ft.

USFWS WETLAND SYSTEM Palustrine

STRATA	MOST ABUNDANT SPECIES
Tall shrub	*Alnus serrulata*, *Rosa palustris*
Herbaceous	*Cladium mariscoides*

DIAGNOSTIC SPECIES
Alnus serrulata, *Sanguisorba canadensis*, *Parnassia grandifolia*, *Carex atlantica*, *Helenium brevifolium*, *Solidago uliginosa*, *Vaccinium macrocarpon*, *Ranunculus caroliniana*, *Rhynchospora capitellata*, *Muhlenbergia glomerata*, *Calopogon tuberosa*, *Cladium mariscoides*.

VEGETATION DESCRIPTION

This community has a mixed physiognomy ranging from shrub thicket to herbaceous. In general it occurs as a shrubland of *Alnus serrulata*, *Spirea latifolia*, *Spirea tomentosa* and *Lyonia ligustrina*. Typically there are a few scattered individuals of *Pinus strobus* and *Acer rubrum* but tree cover rarely reaches 10%. The herbaceous layer is relatively continuous and may be quite diverse. Herbaceous species include *Glyceria striata*, *Juncus subcaudatus*, *Osmunda regalis*, *Oxypolis rigidior*, *Viola cucullata*, *Eleocharis tenuis*, *Cirsium muticum*, *Panicum dichotomum*, *Hedyotis caerulea*, *Oenothera perennis*, *Sanguisorba canadensis*, *Parnassia grandifolia*, *Aster nova-belgii*, *Carex atlantica*, *Helenium brevifolium*, *Solidago uliginosa*, *Calopogon tuberosus*, *Muhlenbergia glomerata*, *Schizachyrium scoparium*, *Xyris torta*, *Panicum virgatum*, *Rhynchospora capitellata*, *Rhynchospora alba*, *Selaginella apoda*.

OTHER NOTEWORTHY SPECIES

The rare species *Trillium pusillum* and *Euphorbia purpurea* may occur in this community type.

CONSERVATION RANK G1

RANK JUSTIFICATION

There are very few occurrences in a restricted range.

COMMENTS

This community is floristically related to some of Virginia's mafic woodlands. Generally this community is less "seepy" and lacks the tree canopy of the woodland types. The species *Calopogon tuberosus*, *Muhlenbergia glomerata*, *Schizachyrium scoparium*, *Xyris torta*, *Panicum virgatum*, *Rhynchospora capitellata*, *Rhynchospora alba*, and *Selaginella apoda* are probably differential to this type.

REFERENCES

Virginia Division of Natural Heritage, field survey forms and particularly the draft table entitled: A classification of seepage wetland vegetation in Virginia based on character-species. T.J. Rawinski, Virginia Department of Conservation & Recreation, Richmond, VA.

Purshia tridentata/Stipa comata Sparse Shrubland

COMMON NAME	Antelope Bitterbrush/Needle-and-Thread Sparse Shrubland
SYNONYM	None
TNC SYSTEM	Terrestrial
PHYSIOGNOMIC CLASS	Sparse Shrubland
PHYSIOGNOMIC SUBCLASS	Mixed evergreen-deciduous sparse shrubland
FORMATION GROUP	Broad-leaved semi-evergreen sparse shrubland with a dominant herbaceous stratum
FORMATION	Broad-leaved semi-evergreen sparse shrubland with medium tall grasses
ALLIANCE	*Purshia tridentata* Sparse Shrubland
CONFIDENCE LEVEL	1

RANGE
The *Purshia tridentata*/*Stipa comata* sparse shrubland is found in the Columbia Basin and Okanogan Valley east-central and southeastern Washington, northeastern Oregon and into western Idaho. Occurrences are known from Douglas, Franklin and Grant Counties, Washington; Morrow County, Oregon; and Ada and Payette Counties, Idaho.

ENVIRONMENTAL DESCRIPTION
The *Purshia tridentata*/*Stipa comata* association occurs in the Columbia Basin, a downwarped, basalt-floored region. Loess is thick in some portions of the region, and alluvial deposits of variable parent materials are patchy along streams and rivers. Thick mantles of sands from periodically glacially-dammed lakes cover some portions of the region. In other areas, valleys and canyons (coulees) have been deeply scoured into the basalt by glacial flooding.

The climate of the region is characterized by a mix of continental and maritime influences. It is in the rain shadow of the Cascades, with annual precipitation between 22.8 cm and 50.8 cm. Between 55% and 75% of the precipitation falls during October through March as snow, and summers are typically dry. Summer temperatures can be hot and winters are typically cold.

This association occurs on flats to gentle slopes of old sand dunes, from 500 ft. to 1300 ft. elevation. It often occurs in a patchwork with sand dunes and sandy Palouse grasslands. The soils are deep, infertile sands.

USFWS WETLAND SYSTEM Not applicable.

STRATA	MOST ABUNDANT SPECIES
Short shrub	*Purshia tridentata*
Herbaceous	*Stipa comata*, *Poa secunda* var. *secunda*
Non-vascular	Information not available.

DIAGNOSTIC SPECIES
Purshia tridentata, *Stipa comata*

VEGETATION DESCRIPTION
The broad-leaved, semi-evergreen shrub, *Purshia tridentata*, is scattered (averaging 20% cover) over an herbaceous layer dominated by the 0.5 m tall perennial bunchgrass *Stipa comata* (averaging greater than 50% cover). The evergreen, microphyllous shrubs, *Chrysothamnus nauseosus* and *C. viscidiflorus* are occasionally present, and increase in cover with disturbance. Another bunchgrass, *Poa secunda* var. *secunda* forms a lower graminoid layer, with 20% to 50% cover. Other locally abundant perennial grasses include *Oryzopsis hymenoides*, *Koeleria macrantha* and *Elymus lanceolatus*. The most constant perennial forb is *Lithophragma glabrum*. A cryptogammic layer is well-developed in the most undisturbed stands.

OTHER NOTEWORTHY SPECIES
The introduced annual grass, *Bromus tectorum*, and annual forb, *Plantago patagonica*, are invaders and increasers in stands of this association disturbed by grazing.

CONSERVATION RANK G2

RANK JUSTIFICATION
This association occurs on an unusual substrate. Additionally, most stands have been converted to circle irrigation croplands, or to cheatgrass-dominated stands, as this type is very sensitive to

grazing. Most stands in Oregon have been converted to a *Bromus tectorum*-dominated vegetation type.

COMMENTS
This association is similar to the *Purshia tridentata-Artemisia frigida*/*Stipa comata* association described for the north-central Colorado by Hess (1981). However, this Pacific Northwest type occurs on old, stabilized sand dunes and has a differing florisitc component from the Colorado association.

REFERENCES
Daubenmire, R. 1970. Steppe vegetation of Washington. Washington Agricultural Experiment Station, Technical Bulletin 62. 131 pp.

Poulton, C.E. 1955. Ecology of the non-forested vegetation in Umatilla and Morrow Counties, Oregon. Ph.D. Dissertation, Washington State University, Pullman, WA. 166 pp.

***Dryas integrifolia*/*Carex* spp. Dwarf Shrubland**

COMMON NAME	Alpine Avens/Sedge Dwarf Shrubland
SYNONYM	None
TNC SYSTEM	Terrestrial
PHYSIOGNOMIC CLASS	Dwarf-shrubland
PHYSIOGNOMIC SUBCLASS	Evergreen dwarf-shrubland
FORMATION GROUP	Needle-leaved and microphyllous evergreen dwarf-shrubland
FORMATION	Needle-leaved and microphyllous evergreen creeping or matted dwarf-shrubland
ALLIANCE	*Dryas integrifolia* Dwarf Shrubland

CLASSIFICATION CONFIDENCE LEVEL 1

RANGE
This association is known only from the alpine area of the Big Snowy Mountains of central Montana.

ENVIRONMENTAL DESCRIPTION
This plant association occurs from 7550 ft. to 8850 ft. elevation in the alpine of an isolated mountain range (separated from the main crest of the Rockies by 240 km). The climate is unusual in that there is a distinct summer peak of precipitation and a winter minimum. Summers are cool and winters cold.

The geologic substrate is Madison limestone, and has formed a gentle topography of low relief. The limestone is very resistant to chemical erosion but is mechanically fractured and has been shaped into numerous frost-patterning phenomena.

Soils are very shallow, alkaline and cobbly, with carbonate accumulations in the lower horizons and high clay content. The surface is covered with a 5 cm - 18 cm deep layer of small gravel and rock fragments, overlying small ridges of soil. The top soil horizon is characterized by organic enrichment (26% organic matter). The soils are unstable and in a constant state of change due to the action of frost.

USFWS WETLAND SYSTEM Not applicable.

STRATA	MOST ABUNDANT SPECIES
Short shrub	*Dryas integrifolia*
Herbaceous	*Carex rupestris*, *Carex pseudoscirpoidea*, *Bistorta vivipara*

DIAGNOSTIC SPECIES
Dryas integrifolia, *Aquilegia jonesii*

VEGETATION DESCRIPTION
This is an alpine tundra association dominated by the low, mat-forming evergreen shrub *Dryas integrifolia* and the perennial sedge *Carex rupestris*. The mats of *Dryas* and *Carex* occur within a matrix of active frost-patterned bare soil, cobbles and rocks. Most other species occurring in this association are found within these *Dryas* mats. In addition to the abundant or constant species, the perennials *Aquilegia jonesii*, *Physaria didymocarpa*, *Sedum rosea* and *Saxifraga oppositifolia* grow scattered in the rock rubble covering the soil. Richness is relatively low compared to other Rocky Mountain alpine tundras.

OTHER NOTEWORTHY SPECIES Information not available.

CONSERVATION RANK G2

RANK JUSTIFICATION
Known only from a small alpine area of 607 ha, this association is, however, not threatened by any known development activities.

COMMENTS
Dryas integrifolia occurs primarily in Canada and Alaska, with only a few populations occurring in the continental US (Montana and reportedly New Hampshire).

REFERENCES
Bamberg, S.A. and J. Major. 1968. Ecology of the vegetation and soils associated with calcareous parent materials in three alpine regions of Montana. Ecological Monographs 38:127-167.

***Atriplex obovata*/*Sporobolus airoides-Sporobolus cryptandrus* Sparse Dwarf Shrubland**

COMMON NAME	New Mexico Saltbush/Alkali Sacaton-Sand Dropseed Sparse Dwarf Shrubland
SYNONYM	None
TNC SYSTEM	Terrestrial
PHYSIOGNOMIC CLASS	Sparse Dwarf-Shrubland
PHYSIOGNOMIC SUBCLASS	Evergreen sparse dwarf-shrubland
FORMATION GROUP	Needle-leaved and microphyllous evergreen sparse dwarf-shrubland with a sparsely vegetated stratum
FORMATION	Needle-leaved or microphylous evergreen intermittently flooded sparse dwarf-shrubland on semi-arid alluvial substrate
ALLIANCE	*Atriplex obovata* Sparse Dwarf Shrubland
CONFIDENCE LEVEL	3

RANGE
The *Atriplex obovata*/*Sporobolus airoides-Sporobolus cryptandrus* association is known only from the upper Rio Puerco watershed of northwestern New Mexico, in Sandoval and McKinley Counties.

ENVIRONMENTAL DESCRIPTION
The *Atriplex obovata*/*Sporobolus airoides-Sporobolus cryptandrus* association occurs in a semi-arid basin of northwestern New Mexico, between 5400 ft. and 6000 ft. elevation. Annual precipitation is variable, ranging from 21 cm to 33 cm, with a peak during July through September. These summer rains are convectional, of short duration and high intensity. Summers are hot.

This association is found on alluvial flats, with 0-2% slopes and fine textured alluvial parent materials. Soils are calcareous Typic Torrifluvents, with clay, fine sandy loam, or silty clay loam textures. Soil depths ranged from 25 to 50 cm, and had little to no rock in the profile.

USFWS WETLAND SYSTEM Not applicable.

STRATA	MOST ABUNDANT SPECIES
Short shrub	*Atriplex obovata*
Herbaceous	*Sporobolous airoides*, *Hilaria jamesii*

DIAGNOSTIC SPECIES
Atriplex obovata, *Sporobolous airoides*, *Sporobolus cryptandrus*

VEGETATION DESCRIPTION
This is a sparsely vegetated dwarf shrubland, with total plant cover < 20%. The dwarf, evergreen shrub *Atriplex obovata* is the dominant species, with cover ranging from 5% to 20%. Other shrubs with trace cover include the succulents *Opuntia imbricata*, *O. polyacantha*, and the deciduous dwarf shrub *Krascheninnikovia lanata*. Several perennial grass species may be present; *Sporobolus airoides* is the most constant and abundant, with *Sporobolus cryptandrus* and *Hilaria jamesia* typically present. Total herbaceous cover averages 4% to 6%, with forbs contributing only trace amounts. Species diversity is very low.

OTHER NOTEWORTHY SPECIES Information not available

CONSERVATION RANK G1

RANK JUSTIFICATION
This association has been described from a small area in northwestern New Mexico. Only 2-4 occurrences known. It occurs in a semi-arid region that has been heavily utilized by livestock, resulting in permanent degradation of many vegetation types there, including this one.

COMMENTS
Other associations dominated by *Atriplex obovata* have not been described for the western United States.

REFERENCES
Francis, R.E. 1986. Phyto-edaphic communities of the upper Rio Puerco watershed, New Mexico. USDA Forest Service Research Paper RM-272. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 73 pp.

Andropogon gerardii-Panicum virgatum/(_Pycnanthemum virginianum-Solidago ohioensis_) Herbaceous Vegetation

COMMON NAME	Big bluestem-Switchgrass/(Mountain mint-Ohio goldenrod) Herbaceous Vegetation
SYNONYM	Lakeplain Wet-mesic Tallgrass Prairie
TNC SYSTEM	Terrestrial
PHYSIOGNOMIC CLASS	Herbaceous
PHYSIOGNOMIC SUBCLASS	Tall grassland
FORMATION GROUP	Temperate tall grassland
FORMATION	Dense tall grassland (> 60% cover) (including sod or mixed sod-bunch graminoids)
ALLIANCE	*Andropogon gerardii-Panicum virgatum* Herbaceous Alliance

CLASSIFICATION CONFIDENCE LEVEL 2

RANGE
This community is found on glacial lakeplain areas in extreme SE Wisconsin (Kenosha county), N Illinois, N Indiana, S Michigan, S Ontario, and N Ohio.

ENVIRONMENTAL DESCRIPTION
Andropogon gerardii-Panicum virgatum/(*Pycnanthemum virginianum-Solidago ohioensis*) Herbaceous Vegetation occurs on level, sandy glacial outwash, sandy glacial lakeplains, and deposits of dune sand in silty/clayey glacial lake plains. The soils are sands, sandy loams, loams, or silty clays with poor to moderate water retaining capacity. There may be temporary inundations after heavy rains or in the spring.

USFWS WETLAND SYSTEM Not applicable.

STRATA	MOST ABUNDANT SPECIES
Herbaceous	*Andropogon gerardii*, *Carex* spp., *Panicum virgatum*, *Schizachyrium scoparium*, *Sorghastrum nutans*

DIAGNOSTIC SPECIES
Andropogon gerardii, *Carex* spp., *Panicum virgatum*, *Pedicularis lanceolata*, *Pycnanthemum virginianum*, *Schizachyrium scoparium*, *Sorghastrum nutans*, *Solidago ohioensis*, *Vernonia* spp.

VEGETATION DESCRIPTION
The vegetation of this community is dominated by tallgrass species typically 1-2 meters high. Trees and shrubs are very rare. There is very little bare ground. *Andropogon gerardii*, *Carex* spp., *Panicum virgatum*, *Schizachyrium scoparium*, and *Sorghastrum nutans* are the most abundant species. *Solidago ohioensis* is found in both fens and Great Lakes interdunal wetlands as well as this community. *Pycnanthemum virginianum* is common in this community but may also occur in woodlands.

OTHER NOTEWORTHY SPECIES
Disturbed sites may contain considerable amounts of *Poa compressa* and *Agrostis gigantea*.

CONSERVATION RANK G2

RANK JUSTIFICATION
This community has nearly been eliminated. Most sites have been converted to cropland.

COMMENTS
This community is similar to other wet and wet-mesic grassland types in its range. One feature of this community that serves to set it apart from other wet grassland types is the presence of species typical of fens and interdunal wetlands. *Solidago ohioensis* is one such species (Pringle 1982). In many cases a Lakeplain Wet-mesic Tallgrass Prairie that is even wetter (dominated by *Spartina pectinata*, *Calamagrostis canadensis*, and *Carex* spp.) forms a relatively narrow zone between Wet-Mesic Tallgrass Prairie and marsh. Occasionally this variant can cover 0.5 ha or more.

REFERENCES
Chapman, K. 1984. An Ecological Investigation of Native Grassland in Southern Lower Michigan. Master's Thesis, Western Michigan University, Kalamazoo.

Faber-Langendoen, D. and P. F. Maycock. 1994. A Vegetation Analysis of Tallgrass Prairie in Southern Ontario. Proceedings of the Thirteenth North American Prairie Conference, August 6-9, 1992 Windsor, Ontario Canada.

Hanson, P. C. 1981. The Presettlement Vegetation of the Plain of Glacial Lake Chicago in Cook County, Illinois. *In* R. L. Stuckey and K. J. Reese eds. Proceedings of the Sixth North American Priarie Conference. The Ohio State University, Columbus, Ohio.

Pringle, J. S. 1982. The Distribution of *Solidago ohioensis*. Michigan Botanist 21(2):51-57.

The Nature Conservancy (TNC). 1991a. Michigan State Community Abstract - Lakeplain Wet-Mesic Prairie. Midwest Regional Office, Minneapolis, MN.

The Nature Conservancy (TNC). 1991b. Michigan State Community Abstract - Mesic Sand Prairie. Midwest Regional Office, Minneapolis, MN.

Sedum nuttalianum-Selaginella peruviana (Granitic Outcrop) Sparse Vegetation

COMMON NAME Nuttall's Sedum-Peruvian Spikemoss Sparse Vegetation

SYNONYM Western Acidic Rock Outcrop

TNC SYSTEM Terrestrial

PHYSIOGNOMIC CLASS Sparsely Vegetated

PHYSIOGNOMIC SUBCLASS Sparsely vegetated consolidated rocks

FORMATION GROUP Sparsely vegetated cliffs

FORMATION Cliffs with chasmophytic vegetation--Plants rooting in fissures of rocks or walls

ALLIANCE *Sedum nuttallianum* Sparsely Vegetated Alliance

CLASSIFICATION CONFIDENCE LEVEL 2

RANGE
This community occurs on outcrops of granite in Texas and Oklahoma. It is known from southwestern Oklahoma, in the Wichita Mountains and from central Texas, in the Central Mineral Region of the Edward's Plateau.

ENVIRONMENTAL DESCRIPTION
This community occurs on gently sloping, exposed massifs of late Precambrian granite. The dominant substrate is medium to coarse grained rock, with patches of coarse gravel and shallow accumulations of organic material in narrow crevices and depressions. Low moisture and nutrient availability are the primary limiting factors for vegetation in this habitat. The climate is characterized by dry winters, and hot-humid summers, with drought and high temperatures occurring during the growing season.

USFWS WETLAND SYSTEM Not applicable.

STRATA	MOST ABUNDANT SPECIES
Not applicable	*Sedum nuttalianum*, *Selaginella peruviana*, *Selaginella riddellii*, *Plantago wrightiana*, *Cheilanthes lindheimeri*, *Pellaea ternifolia*, *Bouteloua* spp., lichens, mosses

DIAGNOSTIC SPECIES
Sedum nuttalianum, *Selaginella peruviana*, *Plantago wrightiana*

VEGETATION DESCRIPTION
This community contains large expanses of exposed granite surfaces, with scattered soil-filled depressions, crevices, gravel areas, and shallow pools. The vegetation is dominated by annuals and species adapted to drought conditions. Bare rock is occupied by scattered patches of crustose and foliose lichens, mosses, and several ferns and fern allies including *Selaginella peruviana*, *Selaginella riddellii*, *Cheilanthes lindheimeri*, *Cheilanthes tomentosa*, *Woodsia obtusa* and *Pellaea ternifolia*. Typical species that occur in areas where shallow sand or gravel accumulate include *Sedum nuttalianum*, *Plantago wrightiana*, *Talinum parviflorum*, *Helenium amarum*, *Campanula reverchonii*, *Aphanostephus skirrhobasis*, *Hypericum gentianoides*. Areas with deeper soils are dominated by *Schizachyrium scoparium* occurring with other grasses such as *Bouteloua hirsuta*, *Bouteloua curtipendula*, and *Aristida purpurea*. Large crevices that contain sufficient soil accumulation support woody species characteristic of the surrounding woodland, including *Quercus stellata*, *Quercus marilandica*, and, *Carya texana*. Narrow. shallow crevices harbor species tolerant of the most xeric conditions including *Echinocereus reichenbachii*, *Eriogonum tenellum*, and *Opuntia leptocaulis*.

OTHER NOTEWORTHY SPECIES
Isoetes lithophila is endemic to the central Texas granite outcrops (Wyatt and Walters 1982).

CONSERVATION RANK G2

RANK JUSTIFICATION
This community has a restricted distribution and is threatened by overgrazing and mining.

COMMENTS
Vegetation dynamics in this community are strongly related to the development of a complex soil depth gradient involving changes in temperature, soil depth, and water holding capacity.

This community has similar microhabitats and shares several common genera with granitic communities in the eastern Gulf and Atlantic coastal plains. Each of these granitic outcrop regions have their own endemic suite of granite-outcrop plants. In the western granitic outcrops, mosses are not as important and the surrounding woodlands are more xeric than in the eastern types (Uno and Collins 1987). The western granitic outcrop communities are typically surrounded by dry woodlands dominated by *Quercus stellata*, *Quercus marilandica*, and *Carya texana*.

REFERENCES

Collins, S. L., G. S. Mitchell, and S. C. Klahr. 1989. Vegetation-environment relationships in a rock outcrop community in southern Oklahoma. Amer. Midl. Nat. 122:339-348.

Uno, G. E., and S. L. Collins. 1987. Primary succession on granite outcrops of southwestern Oklahoma. Bull. Torrey Bot. Club 114:387-392.

Walters, T. W., and R. Wyatt. 1982. The vascular flora of granite outcrops in the Central Mineral Region of Texas. Bull. Torrey Bot. Club 109:344-364.

Whitehouse, E. 1933. Plant succession on central Texas granite. Ecol. 14:391-405.

APPENDIX 11.3 List of Hydrological Modifiers

Hydrological modifiers used to identify wetland units at the formation level (adapted from Cowardin et al. 1979).

Tidal

Irregularly Exposed -- Land surface is exposed by tides less often than daily; the area from mean low tide to extreme low spring tide. The area on NOS charts from seaward edge of light green (mean low water) to depth contour (often in blue tone) approximately extreme low water. (includes some mangrove and/or bald cypress swamps)

Regularly Flooded -- Tidal water alternately floods and exposes the land surface daily, from mean low (lower low on West coast) to mean high (higher high on West coast) tide. (includes cordgrass low marshes)

Irregularly Flooded -- Tidal water floods land surface less often than daily. The area must flood by tide at least once yearly as a result of extreme high spring tide plus wind plus flow. The area extends from mean high water inland to the maximum extent of tide plus the splash zone. (includes salt hay meadows)

Unknown -- The water regime is not known. Unit is described simply as '(wetland).'

Non-Tidal

Permanently Flooded -- Water covers land surface at all times of year in all years. (includes many rooted emergent and floating aquatics)

Semipermanently Flooded -- Surface water persists throughout the growing season in most years. Land surface is normally saturated when water level drops below soil surface. (includes most bald cypress swamps, marshes)

Seasonally/Temporarily Flooded -- Surface water is present during the growing season, but is absent by the end of the growing season in most years. The water table after flooding ceases to be very variable, extending from saturated to a water table well below the ground surface. (includes flood plains and wet meadows)

Saturated -- Surface water is seldom present, but substrate is saturated to surface for extended periods during the growing season. (includes bogs and fens)

Seasonally flooded/saturated -- The water table remains at or near the soil surface following flooding. Standing water can persist in depressions for much of the growing season; the soils are generally saturated when the water table drops below the soil surface. (includes most wooded swamps)

Intermittently flooded -- Substrate is usually exposed, but surface water present for variable periods without detectable seasonal periodicity. This modifier was developed for use in arid Western United States to describe water regimes of playa lakes, and will apply to other areas as well. Inundation is not predictable to a given season and is dependent upon highly localized rain storms. Playa lakes, intermittent streams, and dry washes are only considered to be wetland if they support hydrophytes and/or have hydric soils.

Unknown -- The water regime of the area is not known. The unit is simply described as '(wetland).'

Salinity/Halinity Modifiers

Inland		Coastal Tidal
Saltwater -	>30 ppt	Saltwater-tidal
Brackish -	0.5-30 ppt	Brackish
No Equivalent	<0.5 ppt	Freshwater

APPENDIX 11.4 List of Element Occurrence Record Fields with Brief Descriptions

The purpose of the Element Occurrence Record for Community Elements is to document and describe occurrences of particular community types on the ground.

KEY: Fields with no designated field type are single value
mv=multivalue field
amv=associated multivalue field
txt=text field

IDENTIFIERS

Element Occurrence Code
Record key code.

STATE Community Code
10 byte Element Code that state is using to track the type.

Field Office Number
Code for the Element assigned by the TNC field office for an EO not yet recorded in the Heritage database.

Identity
Check-off indicating whether taxonomic identity of the Element has been confirmed, refuted, or is in question (Y,N,?).

Global Name
TNC Global Community Element name based on Latin name of dominant and diagnostic plant species.

Common Name
TNC Global Community Element name based on common name of dominant and diagnostic plant species.

Sub-national Name
Sub-national Element scientific name.

SubNational Common Name

Sub-national Element common name.

Global Rank
Global Element rank.

National Rank
National Element rank.

State Rank
Sub-national Element rank.

EO LOCATION AND FILE DATA

Nation
Nation where EO is located.

Site Code
Code for the Site where the EO is located.

Site Name
Name of Site where EO is located.

Survey Site (mv)
Name of the area surveyed.

Precision
Code to identify precision used to map Element Occurrence (S,M,G,U)

County Code (amv)
Code(s) for county(ies) where EO is located.

County Name (amv)
Name(s) for county(ies) where EO is located.

Local Jurisdiction (mv)
Name(s) of town, township, or borough in which EO is located.

Quad Name (amv)
Name(s) of topographic map quadrangle(s) where EO is located.

Quad Code (amv)
Code(s) for topographic map quadrangle(s).

Margin Number (amv)
Map margin number(s) used to reference EO on map.

Dot Number (amv)
Number on dot used to label EO on map.

Ten Ten (amv)
Ten-Ten coordinated used to roughly located EO on map.

Latitude
Latitude of EO centrum

Longitude
Longitude of EO centrum

North
Latitude of northernmost boundary of the EO

East
Longitude of easternmost boundary of the EO

South
Latitude of southernmost boundary

West
Longitude of westernmost boundary

Township and Range (amv)
Code for township and range rectangular survey location of EO.

Section (amv)
Code for legal section number for the EO centrum.

Township Range & Section Note (amv)
Additional township, range and section details (esp description of specific legal section divisions).

Meridian (amv)
Legal meridian (2 digits) from which rectangular survey location of EO was based.

Directions (txt)
Precise directions to the EO from prominent landmark on or near site.

Physiographic Province (mv)
Code(s) for physiographic province based on Hammond.

Fenneman's Major Division Number (amv)
Code of Fenneman's Major Division in which the EO is located.

Fenneman's Major Division Name (amv)
Name of Fenneman's Major Division in which the EO is located.

Fenneman's Physiographic Province Number (amv)
Code for Fenneman's physiographic province in which the EO is located.

Fenneman's Physiographic Province Name (amv)
Name of Fenneman's physiographic province in which the EO is located.

Ecoregion Author Number (amv)
Code for author(s) whose ecoregionalization was used to locate the EO, (i.e. Bailey, Omernik, etc.).

Ecoregion Author Name (amv)
Name for author(s) whose ecoregionalization was used to locate the EO.

Ecoregion Primary Number (amv)
Code for the primary level of the ecoregionalization hierarchy in which the Element is located.

Ecoregion Primary Number (amv)
Name for the primary level of the ecoregionalization hierarchy in which the Element is located.

Ecoregion Secondary Number (amv)
Code for the secondary level of the ecoregionalization hierarchy corresponding to the primary level chosen in the Ecoregion Primary Number field.

Ecoregion Secondary Name (amv)
Name of the secondary level of the ecoregionalization hierarchy.

Other Regions (txt)
Any other global, national, state, or local locators (Eg. State Ecoregions).

Watershed(mv)
Code for watershed (from USGS Hydrologic unit map) where EO centrum is located.

STATUS

Survey Type (mv)
Code indicating the level of detailed data collected on the EO.

Survey Date
Date of most recent field survey.

Last Observance
Date EO was last observed at site (yyyy-mm-dd)

First Observance
Year EO was first observed at site (yyyy-mm-dd)

Element Occurrence Rank
Rank indicating the quality, condition, viability, and defensibility of the Element Occurrence.

Element Occurrence Rank Date
Date of field survey used to rank the EO (yyyy-mm-dd).

Element Occurrence Rank Comments (txt)
Comments justifying the Element Occurrence Rank assigned.

Contact Identifier (amv)
Code(s) from contacts database for person monitoring EO and any other local residents, neighbors, etc.

Contact Name (amv)
Name of the contact cited in the Contact Identifier field.

Contact Note (amv)
Brief note explaining the relationship of each Contact listed to the Element Occurrence (e.g. "monitor", "owner", "neighbor").

ENVIRONMENTAL DATA

Latitude Zone (mv)
Latitudinal zone(s) on which EO occurs.

Minimum Elevation
Minimum elevation of EO.

Maximum Elevation
Maximum elevation of EO.

Landform (mv)
Landform(s) on which Element is located.

Topographic Position (mv)
Topographic position of the EO on the landscape.

Slope (mv)
Range of slope(s) on which EO is located

Aspect (mv)
Aspect(s) of slope(s) on which EO is located.

Geology Comments (txt)
Comments on geologic substrate and other important geologic features on which the Element generally occurs.

Soil Type (mv)
Soil type(s) based on any level of taxonomy available: Soil survey map unit, series, great group, etc. as detailed as existing information allows.

Soil Moisture (mv)
The amount of water available to plants. Based on soil drainage, soil structure and texture, and climate.

Soil Comments (txt)
Comments on soil properties. Include information on how soil information was collected, a description of soil texture, stoniness, root penetration, notes on horizon depths, mottling, pH etc. Comment on the level of taxonomy of soil listed in Soil Type field.

Hydrologic Influence (txt)
Comments on hydrologic influences on the community including: zonation reflecting water level fluctuations, tidally influenced, permanent or temporary, hydrologic seasonality, standing water, etc.

Environment Comments (txt)
Summary of environmental conditions associated with the EO, and any additional comments on important environmental factors.

DESCRIPTION

General Description(txt)
General description of area of the EO. Including information on state/health of the landscape unit; degree of fragmentation and overall disturbance/conversion; any distinguishing features of the landscape.

Size
Size of EO in acres.

System
Name for TNC System.

Class
Name of physiognomic class.

Subclass
Name of physiognomic subclass.

Group
Name of formation group.

Formation
Name of formation.

Alliance
Name of alliance.

Leaf Type
Leaf morphology of the dominant strata in the Element.

Leaf Phenology
Leaf phenology of the dominant strata in the Element.

Strata and Lifeform (amv)
Layers of vegetation occurring within the Element.

Percent Cover (amv)
Percent cover of each layer.

Height (amv)
Height of each layer.

Most Abundant Species (amv)
Most abundant (in terms of percent cover) plant species in each layer.

Diagnostic Species (amv)
Diagnostic plant species (dominant, differential, characteristic, or indicator) which are relatively constant among occurrences of the Element and help to classify it.

Unvegetated Surface (amv)
Description of unvegetated substrate.

Unvegetated Surface Cover (amv)
Percent cover of unvegetated substrate.

Other Species Comments (txt)
Other species found in EO. This may include comments on known endemics or exotics.

Fauna (mv)
Animal species sighted in the EO.

Homogeneity (txt)
Comments indicating the degree of homogeneity of the EO. Describe any heterogeneous features.

Spatial Distribution (txt)
Comments on whether this Element Occurrence is patchy, or one continuous patch on the landscape.

Adjacent Communities (txt)
Name(s) of communities adjacent to the EO. Comment on their spatial relationship to this Element Occurrence.

Inclusion Communities (txt)
Name(s) of distinct associations included within the EO (i.e. heath bog within an occurrence of mixed coniferous forest).

Mosaic Comments (txt)
If the Element Occurrence represents a complex mosaic of sub-associations such as Dune/Swale communities, or zonal coastal plain pond shores, indication of the scale and pattern of the components.

Succession and Dynamics Comments (txt)
Comments on vegetation successional stage (early, mid, late) and trend or cycle. Notes on indicators of successional trends (such as the presence of seedlings/saplings or non-canopy species). If persistent, indicate as such. Comments on the age structure/size structure of the community occurrence.

DISTURBANCE

Condition
Code for condition of EO which describes the degree of anthropogenic disturbance to the community.

Disturbance Comments (txt)
Comments on any natural or anthropogenic disturbance to community. Including overstory and groundcover disturbances, logging, animal use evidence, erosion, disturbance history (if known) etc.

INVENTORY, SAMPLING, AND ANALYSIS

Image Reference (amv)
Code of imagery used to identify this EO which is referenced in Source Abstract database.

Image Citation (amv)
Citation corresponding to images listed in Image Reference field.

Roll and Frame Note (amv)
Specific roll and frame numbers or flight-lines for the imagery listed in Image Reference Field.

Annotation (amv)
If polygon has been entitated on imagery, code that is annotated on the image.

Imagery Comments (txt)
Comments on imagery used including level of precision, how EO was transferred from image to maps, image verification procedures, image classification notes, etc.

Quantitative Method
If quantitative methods were used to collect data on the EO, indication of whether plot or plotless techniques were used.

Plot Shape (amv)
If plots used to collect information for this EO, plot shape.

X Dimension (amv)
Length of one side of rectangular plots. For circular plots, he length of the radius. If a transect was used, enter length. Units should be converted to meters.

Y Dimension (amv)
Length of second side of rectangular plots. Blank for circular plots. For transects, enter a 1.

Plot Area (amv)
Plot area calculated from X Dimension and Y Dimension.

Sample Number (amv)
Number of plots used. If transect used, enter the number of sample points.

Subplot (amv)
Check-off indicating whether plots are subplots of a larger plot? (Y/N)?

Permanent (amv)
Check-off indicating whether any of the plots are permanently marked for future study (Y/N)?

Plot Representativeness (txt)
Comments on the relative representativeness of the sample plots. Describe how well they reflect the EO as a whole.

Sample Location (txt)
Detailed directions to plot(s). Give global positioning system (GPS) coordinates if available. Include the precision of the GPS coordinates for the sample.

Plotless Comments(txt)
Description of plotless data collection methods used.

Data Location Note (txt)
Storage location of data collected on the occurrence (manual file location, spreadsheet file name and location, etc.)

Inventory Comments (txt)
Comments on any other important information collected in the ground survey. What were the objectives for the inventory? Was a species list collected? Was this a result of a plot remeasurement? Reason for no plot? etc.

PROTECTION

Managed Area Code (amv)
Managed Area code(s) for the Managed Area(s) where the EO is located.

Managed Area Name (amv)
Name(s) of Managed Area(s) where EO is located.

Managed Area Type (amv)
Code indicating the type of Managed Area (e.g. National Park, Wildlife Refuge, etc.).

Contained (amv)
Check-off indicating whether EO is wholly contained in the Managed Areas listed (Y/N/?).

More Land
Check-off indicating whether more land (ie. additional acreage) needs to be protected (ie. at least registered) in order to adequately protect the EO (Y/N/?).

More Protection
Check-off indicating whether a higher level of protection is needed (on existing Managed Areas or protected Tracts) in order to adequately protect the EO (Y/N/?).

More Management
Check-off indicating whether more management effort is needed in order to adequately protect the EO (Y/N/?).

TNC Involvement
Check-off indicating whether TNC was involved in protection of this EO (Y/N).

Management Comments (txt)
Comments concerning the management of the EO. Describe any known or obvious short- or long-term threats to the EO and any known economic value(s) associated with this EO.

Protection Comments (txt)
Comments concerning the protection of the EO.

Monitoring Needs (txt)
Comments on monitoring needs for EO.

Research Needs (txt)
Comments on research needs for EO.

<u>OWNERSHIP</u>

Owner (mv)
Name(s) of owner(s) on which EO is located.

Owner Information
Check-off indicating whether additional information on the owner is available (Y/N).

Owner Comments (txt)
Comments concerning the owner(s) of the land where the EO is located.

GENERAL COMMENTS

Comments (txt)
Any general comments about the EO that don't need to be specifically tracked which haven't been entered in other fields.

DOCUMENTATION

Data Sensitivity
Check-off indicating whether security is needed for sensitive data (Y/N).

Boundaries
Check-off indicating whether the EO boundaries have been delineated on a USGS topo map (Y/N/?).

Photos
Check-off indicating whether a photo (not imagery) of the EO exists (Y/N).

Best Source (txt)
Name of single best source of information on the EO (person or literature).

Source Code (amv)
List of sourcecodes for sources about the Element from the Source Abstract.

Citation (amv)
Citation from source(s) listed in Source Code field.

Transcriber
Date of original EOR transcription, and initials of transcriber (yy-mm-dd abc).

Mapper
Date EO was mapped on the Heritage Program's quad map and initials of the mapper (yy-mm-dd abc).

County of Distribution Revised
Check-off indicating whether county of distribution map been revised to reflect location of EO (Y/N).

Quality Control
Check-off indicating whether a full (2 stage) quality control check has been completed for this record. (Y/N)

ADDITIONAL TOPICS

Additional Topics (txt)
Specific comments on any significant additional topics concerning the Element Occurrence which need to be tracked that have not been formally addressed by one of the standard fields in the record.

Topic Keywords (mv)
List of topics considered in the preceding Additional Topics field.

RECORD MAINTENANCE

Lead Responsibility
Abbreviation for name of the office that is responsible for keeping the data in this record up-to-date.

Edition
Date (yy-mm-dd) of the current edition of this record (either first completed or comprehensively revised).

Edition Author
Name of author of current edition of this record.

Update
Date and initials of person to make any revisions to the record, either correction of typos or comprehensive revisions.

APPENDIX 11.5 List of Community Characterization Abstract Fields with Brief Descriptions

The purpose of the Community Characterization Abstract is to summarize classification and descriptive information on a community type.

KEY: Fields with no designated field type are single value
mv=multivalue field
amv=associated multivalue field
txt=text field

IDENTIFIERS

Element Code
Variable length code for the Element.

Summary
A one paragraph abstract for the Community Element described in this record.

Global Name
TNC Global Community Element based on Latin names of dominant and characteristic plant species. Regional names can be used temporarily while global species complex names are being developed.

Author
Individual(s) responsible for assigning GNAME.

Common Name
TNC Element common name.

CLASSIFICATION

System
Name for TNC System.

Class
Name of physiognomic class.

Subclass
Name of physiognomic subclass.

Group
Name of formation group.

Formation
Name of formation.

Alliance
Name of alliance.

Crosswalked
Check-off indicating whether the regional classifications been crosswalked to complete this record (Y/N).

Confidence Level
Indication of the level of confidence in the type.

Classification Comments (txt)
Comments on any taxonomic problems for the type.

Similar Communities (txt)
List of closely related or apparently similar communities and comments on how they differ from the global type.

RELATED NOMENCLATURE

Heritage Names (amv)
List of any regional, state or subnational, and CDC names for the Element.

Heritage Name Relationship (amv)
Indication of the relationship of the Heritage Names to the Global Name (>,<,=).

Heritage Name Relationship Note (amv)
Brief description of the relationship to the GNAME.

Habitat Number (amv)
Code for TNC habitats.

Habitat Name (amv)
Name for TNC habitats.

Habitat Modifier Number (amv)
Code for habitat modifier corresponding to the value chosen in Habitat Number field.

Habitat Modifier Name (amv)
Code for habitat modifier.

Society of American Foresters Region Number (amv)
Code for Society of American Foresters Cover Type Region.

Society of American Foresters Region Name (amv)
Name for Society of American Foresters Cover Type Region.

Society of American Foresters Covertype Number (amv)
Code for covertype(s) used by the Society of American Foresters that include this Element (Popup).

Society of American Foresters Covertype Name (amv)
Name for covertype used by the Society of American Foresters.

Kuchler Lifeform Number (amv)
Code for lifeform of the Element from Kuchler's Potential Vegetation Map of the United States.

Kuchler Lifeform Name (amv)
Name for Kuchler's lifeform.

Kuchler Potential Natural Vegetation Type Number (amv)
Code(s) of Kuchler's potential natural vegetation types that include this Element (Popup).

Kuchler Potential Natural Vegetation Type Name (amv)
Name(s) of Kuchler's potential natural vegetation types that include this Element.

UNESCO Class Number (amv)
Code for UNESCO's physiognomic class which best describes the Element (Popup).

UNESCO Class Name (amv)
Name for UNESCO's physiognomic class which best describes the Element.

UNESCO Formation Number (amv)
Code for UNESCO's formation level classification (Popup).

UNESCO Formation Name (amv)
Name for UNESCO's formation.

USFWS Wetland Type Number (amv)
Code for US. Fish and Wildlife Wetland Type (Popup).

USFWS Wetland Type Name (amv)
Name for US. Fish and Wildlife Wetland Type.

USFWS Wetland Type Relation (amv)
Indication of the relationship of the USFWS Wetland Type Names to the Global Name (>,<,=).

USFWS Wetland Type Relation Note (amv)
Brief description of the relationship to the Global Name

Other Names (amv)
Any other names used by other systems or agencies. Specify the source and provide reference if available.

Other Names Relation (amv)
Indication of the relationship of the GOTHER.NAMES to the GNAME. The relation will be designated by the author of the Global Element Name.

Other Names Relation Note (amv)
Brief description of the relationship to the Global Name.

Global Names Comments (txt)
Summary of related names used for the Element. Also comments on the relationship of these types to the type. Also, any other comments on related nomenclature.

DISTRIBUTION

Fenneman's Major Division Number (amv)
Code of Fenneman's Major Division in which the Element is located.

Fenneman's Major Division Name (amv)
Name of Fenneman's Major Division in which the Element is located.

Fenneman's Physiographic Province Number (amv)
Code for Fenneman's physiographic province in which the Element is located.

Fenneman's Physiographic Province Name (amv)
Name of Fenneman's physiographic province in which the Element is located.

Ecoregion Author Number (amv)
Code for author(s) whose ecoregionalization was used to locate the Element (i.e. Bailey, Omernik, etc.).

Ecoregion Author Name (amv)
Name for author(s) whose ecoregionalization was used to locate the Element.

Ecoregion Primary Number (amv)
Code for the primary level of the ecoregionalization hierarchy in which the Element is located.

Ecoregion Primary Number (amv)
Name for the primary level of the ecoregionalization hierarchy in which the Element is located.

Ecoregion Secondary Number (amv)
Code for the secondary level of the ecoregionalization hierarchy corresponding to the primary level chosen in the Ecoregion Primary Number field.

Ecoregion Secondary Name (amv)
Name of the secondary level of the ecoregionalization hierarchy.

Region (mv)
Other geographic regional delimiters where Element is located.

Heritage Task Force Region (mv)
The Nature Conservancy's Heritage Task Force Region(s) where Element occurs.

Other Regions (txt)
Any other regional locators (government agencies etc.) that describe the regions of occurrence of the Element.

Global Range
Code indicating the estimated present size of the Elements global range.

Global Range Comments (txt)
Description of the Element's present and historic range. Describe the relationship of original to current range. Comment on shifting boundaries of the range and change of the extent of the occurrence of the community within the range.

Range Map
Check-off indicating whether a range map exist? (Y/).

Rangemap Location (txt)
Location of range map.

Distribution Comments (txt)
Summary of the distribution of the Element, and any additional comments on its distribution.

ENVIRONMENTAL FACTORS

Latitude Zone (mv)
Latitudinal zone(s) over which Element occurs.

Minimum Elevation
Minimum elevation at which Element occurs globally.

Maximum Elevation
Maximum elevation at which Element occurs globally.

Landform (mv)
Landform(s) on which Element is generally located.

Topographic Position (mv)
Topographic position(s) of the Element on the landscape.

Slope (mv)
Range of slopes on which Element occurs.

Aspect (mv)
Range of aspects over which Element occurs.

Geology Comments (txt)
Comments on geologic substrate and other important geologic features on which the Element generally occurs.

Soil Type (mv)
Soil type(s) based on any level of taxonomy available: Soil survey map unit, series, great group, etc. as detailed as existing information allows.

Soil Moisture (mv)
The amount of water available to plants. Based on soil drainage, soil structure and texture, and climate .

Soil Comments (txt)
Comments on soil properties. Include information on how soil information was collected, a description of soil texture, stoniness, root penetration, notes on horizon depths, mottling, pH etc. Comment on the level of taxonomy of soil listed in Soil Type field.

Hydrologic Influence (txt)
Comments on hydrologic influences on the community including: zonation reflecting water level fluctuations, tidally influenced, permanent or temporary, hydrologic seasonality, standing water, etc.

Seasonal Variation (txt)
Description of important seasonal influences/variations.

Key Environmental Factors (txt)
Comments on important environmental determinants of the biological composition or structure of this community and/or its subtypes.

Environment Comments (txt)
Summary of environmental conditions associated with the Element, and any additional comments on important environmental factors.

BIOLOGICAL AND STRUCTURAL DESCRIPTION

Leaf Type
Leaf morphology of the dominant strata in the Element.

Leaf Phenology
Leaf phenology of the dominant strata in the Element.

Strata and Lifeform (amv)
Layers of vegetation occurring within the Element.

Percent Cover (amv)
Percent cover of each layer.

Height (amv)
Height of each layer.

Most Abundant Species (amv)
Most abundant (in terms of percent cover) plant species in each layer.

Diagnostic Species (amv)
Diagnostic plant species (dominant, differential, characteristic, or indicator) which are relatively constant among occurrences of the Element and help to classify it.

Unvegetated Surface (amv)
Description of unvegetated substrate.

Unvegetated Surface Cover (amv)
Percent cover of unvegetated substrate.

Constant Species (mv)
Plant species likely to be found in every occurrence of the Element, but that can also be found in other communities.

Characteristic Species (mv)
Key plant species which generally occur only in this community type, but may not necessarily be found in every occurrence of the type.

Vegetation Comments (txt)
Summary description of the leaf type and phenology, physiognomy and plant species

composition of the Element and any additional comments on vegetation attributes of the Element.

High Ranking Species (mv)
Names of rare or threatened plant or animal species that are expected to be found within occurrences of this Element.

Fauna Comments (txt)
Comments on animals commonly associated with this type.

Other Species Comments (txt)
Summary of other noteworthy species associated with the Element and any additional comments on important species not listed above such as information on endemics or exotics commonly associated with the type.

Species Composition Variability (txt)
Comments on variability in species composition within and among occurrences.

Physiognomic Variability (txt)
Comments on structural variation and patterns within and among occurrences.

Subtypes (txt)
Comments on subtypes of this Element recognized at the global level.

Variability Comments (txt)
Summary of the variability in species composition and physiognomy within and among occurrences of the type and any additional comments on variability associated with the type.

DYNAMIC PROCESSES

Natural Disturbance (txt)
Comments on the type and duration of natural disturbances (on any scale) particular to this Element type.

Successional Status
Successional status of the community (early, middle, late).

Succession and Dynamics Comments (txt)
Summary of successional relationships and temporal dynamics. What are the past and future successional stages known for this community? Given the disturbance regimes, what

successional dynamics are predicted? Include additional comments on age/size structure, dispersal agents, old growth forest characteristics, etc.

SPATIAL RELATIONS

Size (txt)
Comments on the common size of Element Occurrences.

Spatial Distribution (txt)
Comments on whether this Element is generally patchy, or often one continuous patch on the landscape.

Adjacent Communities (txt)
Name(s) of other community types commonly adjacent to this Element. Comment on their spatial relationships across the landscape

Inclusion Communities (txt)
Name(s) of community types frequently occurring within this Element (ie. heath bog within an occurrence of mixed coniferous forest).

Mosaic Comments (txt)
If the Element represents a complex mosaic of sub-associations such as Dune/Swale communities, or zonal coastal plain pond shores, indication of the scale and pattern of the components.

Spatial Comments (txt)
Summary of and additional comments on spatial relationships of this community to others on the landscape.

STATUS

Global Rank
Global Element rank which characterizes the relative rarity or endangerment of the Element world-wide.

Rank Reasons (txt)
Reason for assigning the Global Element Rank.

Exemplary Element Occurrence
Element Occurrence Code for the "best" example of an Element Occurrence.

Exemplary Element Occurrence Site Name
Name for site on which the Exemplary Element Occurrence is located.

Element Occurrence Specifications (txt)
Specification criteria for an Element Occurrence.

Status Comments (txt)
Summary of and additional comments on the global conservation status of the Element.

MANAGEMENT

Economic Importance Comments (txt)
Comments on economic uses of this type. ie. timber and forest products usage, recreation, flood control, groundwater recharge, any other economically important species, etc.

Management Comments (txt)
Summary and additional comments on the management of the community including threats, management strategies for exotics, animal usage, restrictions to size/shape for stability, sustainability, strategies for compatible uses, etc.

INVENTORY AND SAMPLING PROCEDURES

Imagery Comments (txt)
Comments on imagery that is useful for identifying the Element - Can the community be easily distinguished from other communities on imagery, eg. from adjacent communities and from similar communities; comments on types and scales of useful imagery.

Sample Strategy (txt)
Comments on the best way to sample this community. Describe any unusual sampling procedures that are specific to the type.

Inventory Comments (txt)
Summary and additional comments on the recommended sampling strategy for the community. Include information on the best imagery, overflight, and ground survey methods used for the type.

ANALYSIS PROCEDURES AND DATA MANAGEMENT

Analysis Comments (txt)
Description of the data and analysis procedures that were used to determine this type.

Data Location Note (txt)
Storage location of the numerical data used to determine the type.

Permanent Plot
Checkoff indicating whether a permanent plot exists for this type (Y/N).

Permanent Plot Location (txt)
Location of permanent plot. Include Element Occurrence Numbers and site names, if available.

Analysis and Data Management Comments (txt)
Summary and additional comments on the analysis procedures and data used to determine the type.

GENERAL COMMENTS

Community Comments (txt)
Any other comments about this community not covered in the fields above.

REFERENCES

Source Code (amv)
List of sourcecodes for sources about the Element from the Source Abstract File.

Citation (amv)
Citation from source(s) listed in Source Code field.

RECORD MAINTENANCE

Edition
Date (yy-mm-dd) of the current edition of this record (either first completed or comprehensively revised).

Edition Author
Name of author of current edition of this record.

Update
Date and initials of person to make any revisions to the record, either correction of typos or comprehensive revisions.

APPENDIX 11.6 The Nature Conservancy's Conservation Ranking System

This table lists the general criteria used by The Nature Conservancy and the Natural Heritage Network to assign global and state (in parentheses) ranks to species and communities.

G1(S1) = Critically imperiled globally (statewide) because of extreme rarity (5 or fewer occurrences or very few remaining acres or because of some factor(s) making it particularly vulnerable to extinction).

G2(S2) = Imperiled globally (statewide) because of extreme rarity (6 to 20 occurrences or few remaining acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.

G3(S3) = Either very rare and local throughout its range or found locally, even abundantly, in a restricted range (e.g., a single western state, a physiographic region in the East) or because specific factors make it vulnerable to extinction throughout its range (21 to 100 occurrences).

G4(S4) = Apparently secure globally (statewide), though it may be quite rare in parts of its range, especially at the periphery.

G5(S5) = Demonstrably secure globally (statewide), though it may be quite rare in parts of its range, especially at the periphery.

GU(SU) = Possibly in peril range-wide, but status is uncertain.

GX(SX) = Believed to be eliminated throughout range with virtually no likelihood that it will be rediscovered (e.g., American Chestnut forest).

G?(S?) = Element is not yet ranked.

A **"Q"** qualifier can be added to any rank to denote questionable taxonomy (e.g., G2Q = Known to be imperiled, but questions exist concerning the classification of this type).
A "?" qualifier can be added to any rank to denote an inexact numeric rank (e.g., G1? = Believed to be critically imperilled, but some doubt concerning status exists).

Ranks can be combined to indicate a range. (e.g., G2/G3 = may be imperiled or rare throughout range, but the exact status is uncertain). Combined ranks indicate a larger margin of error than ranks assigned a "?" qualifier.