NATIONAL VEGETATION CLASSIFICATION STANDARD, VERSION 2

FGDC-STD-005-2008

QUICK START GUIDE

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1. Purpose of this document

This document provides information related to the National Vegetation Standard v. 2 (FGDC-STD-005-2008), formally endorsed by the FGDC in February 2008. The purpose is to help all those involved in vegetation collecting and reporting understand the mechanics of the National Vegetation Standard and provide a framework to ensure broader acceptance of the standard by all entities involved in vegetation data collection and reporting.

Executive Order 12906 (Clinton 1994) requires all federal agencies involved in the collection and production of geospatial data to conform to the data requirements of all relevant standards adopted through the Federal Geographic Data Committee (FGDC) process. Universal acceptance of standards, though, requires voluntary participation by others, such as state, tribal, and local agencies, university research units, and others involved in geospatial data collection and reporting. However, few resources exist to aid in implementation of the various standards.

This document is intended primarily for individuals involved in the collection and reporting of vegetation data, the goal thereof to ensure that data are collected and reported in a manner consistent with the goals of the National Vegetation Classification Standard. As such, it focuses primarily in the structure of the National Vegetation Classification, itself, rather than the process of assigning vegetation to specific types or defining new types.

To view the standard in its entirety, see:

http://www.fgdc.gov/standards/projects/FGDC-standards-projects/

2. National Spatial Data Infrastructure

The Federal Geographic Data Committee (FGDC) is a 19-member interagency government committee charged with promoting the coordinated development, use, dissemination, and sharing of geospatial data. This nationwide effort is known as the National Spatial Data Infrastructure (NSDI). In order to meet the objectives of the NSDI, the FGDC, in consultation and cooperation with State, local, and tribal governments, the private and academic sectors, and, when feasible, the international community, develops and promotes the use of geospatial data standards.

Under Executive Order 12906 (Clinton 1994), federal agencies collecting or producing geospatial data, either directly or indirectly, are mandated to collect data in a manner that adheres to all relevant standards adopted through the FGDC process. Unless otherwise mandated through contract or agreement, FGDC standards are voluntary for non-federal agencies.

FGDC Standards are developed in response to the Office of Management and Budget (OMB) Circular A-16 (1990; revised 2002) and Executive Order 12906 (Clinton 1994). FGDC Standards define data content, data models, data quality, documentation requirements, and transfer of geospatial data. They are designed to reduce data duplication and data collection costs by providing a consistent, reliable means to organize and share geospatial data. FGDC standards are developed by subcommittees and working groups through a structured process. To the extent possible, various standards are integrated with one another. Currently, the FGDC endorses 22 standards, while an additional 19 standards are in development.

For more information see: www.fgdc.gov

3. National Vegetation Classification

3.1. Overview

Efficient stewardship of the nation's biological resources requires a systematic inventory and classification of the systems which support these resources (Grossman *et al*. 1998). However, until recently, a single classification system utilized across jurisdictional boundaries and throughout multiple collecting agencies was non-existent. Rather, conservation priorities were focused primarily at the local and regional scales, with inventory and mapping standards varying from one area to the next. Inconsistent standards of inventories and classifications compounded the difficulties inherent in management of biological resources, namely the ability to present multi-scale, synoptic views of vegetation resources.

In order to address these problems, the FGDC Vegetation Subcommittee was formed to develop a single vegetation classification and mapping standard for the United States (Grossman *et al*. 1994; Grossman *et al*. 1998; Anderson *et al*. 1998). This effort resulted in the U.S. National Vegetation Classification Standard, accepted by the Federal Geographic Data Committee in 1997 (FGDC 1997).

It was recognized at the time the Standard was adopted that it was far from complete (Grossman *et al*. 1998). Work on refinements and further developments began immediately (Loucks 1995). In October 2007, the FGDC Vegetation Subcommittee released the National Vegetation Classification Standard, Version 2—Working Draft (FGDC 2007), a proposed revision representing a substantial overhaul of the original Standard. The FGDC formally endorsed by the National Vegetation Standard, Version 2 in February 2008.

3.2 Objective

The National Vegetation Classification Standard (hereafter Standard) is designed to ensure consistent standards for vegetation data collected at local, regional, and national levels. This will allow the production of uniform statistics about vegetation resources across the nation, enable the translation of data collected at various scales, and allow data sharing, aggregation, and comparisons across regions. In addition to providing an orderly means to develop a national vegetation classification, the Standard is designed to provide collaboration with international vegetation classification activities.

In order to ensure data aggregation across all federal agencies, the Standard requires vegetation classification efforts to meet minimum data requirements. The Standard also establishes procedures for classifying existing vegetation for the United States and its Trust Territories and establishes minimum metadata requirements for consistent status reporting on the Nation's vegetation resources.

3.3 The Classification

The National Vegetation Classification (hereafter NVC) is a hierarchical system designed to classify existing vegetation (i.e. plant cover, floristic composition, and vegetation structure documented to occur in a specific area at a specific time) on the basis of both physiognomic and floristic criteria. The upper levels of the classification are physiognomic, based primarily on growth form, structure, and cover, while the lower levels are floristic, based primarily on species composition and abundance. The middle-tiered levels are based on a combination of physiognomic and floristic characteristics.

The NVC also differentiates between natural and cultural vegetation, with separate hierarchies for each. Natural (and semi-natural) vegetation is vegetation in which species and site characteristics are determined primarily by ecological processes (Küchler 1969, Westhoff and van der Maarel 1973). Where the structure, composition, and development of vegetation are determined by regular human activity the vegetation is defined as cultural vegetation (Küchler 1969). Natural vegetation may be influenced by human activity such as logging, fire, and grazing, to varying degrees. Vegetation that

has been shaped by both anthropogenic disturbances and ecological processes (e.g. old fields) is defined as semi-natural vegetation

The NVC encompasses all areas having one percent or more of their surface area with live vegetation. Non-vegetated natural lands and water and non-vegetated cultural lands and water are excluded from the NVC (Table 1).

VEGETATED AREAS	**Natural Vegetation**	**Cultural Vegetation**
Upper		
	Level 1-Formation Class	Level 1-Cultrual Class
	Level 2- Formation Subclass	Level 2-Cultrual Subclass
	Level 3- Formation	Level 3-Cultrual Formation
		Level 4-Cultrual Subformation
Mid		
	Level 4-Division	Level 5-Cultural Group
	Level 5-Macrogroup	Level 6-Cultural Subgroup
	Level 6-Group	
Lower		
	Level 7-Alliance	Level 7-Cultural Type
	Level 8-Association	Level 8-Cultural Subtype
NONVEGETATED AREAS	Not included in the NVC.	

Table 1. National Vegetation Classification Hierarchy

Natural Vegetation

As indicated in Table 1, the natural vegetation hierarchy is composed of eight classification levels in three hierarchical tiers (upper, mid, and lower). All levels of the hierarchy are primarily defined by varying degrees by physiognomic and floristic criteria. Habitat factors and/or management practices are not an explicit part of the hierarchy, though they may be used to help interpret the vegetation. All type descriptions should be derived from field plot data in which species, abundance, growth forms, locational information, habitat setting, and overall vegetation structure are described. However, in instances in which plot data are unavailable or available in limited number, literature and other data sources may be used to describe vegetation types.

The natural vegetation hierarchy uses five vegetation criteria to classify vegetation at all levels of the hierarchy: diagnostic growth forms; dominant growth forms; compositional similarity; diagnostic species; and dominant species. At the upper levels of the hierarchy, emphasis is placed on dominant and diagnostic growth forms; at the middle levels of the hierarchy, on compositional similarities, character species, and diagnostic and dominant growth forms; and at the lower levels, on diagnostic and/or dominant species and compositional similarities.

The eight levels compromising the natural vegetation hierarchy of the NVC are described below.

Upper-level units:

The upper-level units consist of three classes defined on the basis of physiognomic and ecological factors.

1. **Formation Class**: A broad combination of dominant general growth forms that correspond to global moisture and temperature regimes and/or substrate or aquatic conditions.

2. **Formation Subclass**: A combination of general dominant and diagnostic growth forms reflecting global macroclimatic factors driven primarily by latitude and continental position or reflecting the overriding substrate or aquatic conditions.

3. **Formation**: A combination of general dominant and diagnostic growth forms reflecting global macroclimatic factors including by elevation, seasonality of precipitation, and soil moisture conditions**.**

Mid-level units:

The mid-level units consist of three classes defined on the basis of both physiognomic and floristic units.

4. **Division**: A combination of dominant and diagnostic growth forms and a broad set of diagnostic plant taxa reflecting biogeographic differences in composition and continental differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes.

5. **Macrogroup**: A combination of moderate sets of diagnostic plant species and diagnostic growth forms reflecting biogeographic differences in composition and sub-continental to regional differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes.

6. **Group**: A combination of relatively narrow sets of diagnostic plant species (including dominants and co-dominants), broadly similar composition, and diagnostic growth forms reflecting biogeographic differences in mesoclimate, geology, substates, hydrology, and disturbance regimes.

Lower-level units:

The lower-level units consist of two classes defined on the basis of floristic units.

7. **Alliance**: A characteristic range of species composition, habitat conditions, physiognomy, and diagnostic species, typically at least one of which is found in the uppermost or dominant stratum of the vegetation and reflecting regional to subregional climate, substrates, hydrology, moisture/nutrient factors, and disturbance regimes. An alliance consists of one or more associations.

8. **Association**: A characteristic range of species composition, diagnostic species occurrence, habitat conditions, and physiognomy reflecting topo-edaphic climate, substrates, hydrology, and disturbance regimes.

Table 2 shows the eight hierarchical levels of the natural vegetation classification and provides common name examples for each.

Natural Vegetation Hierarchy	Example
Upper	
Level 1-Formation Class	Grassland and Shubland
Level 2- Formation Subclass	Temperate and Boreal Grassland and Shrubland
Level 3- Formation	Temperate Grassland, Meadow & Shrubland
Mid	
Level 4-Division	North American Great Plains Grassland and Shrubland
Level 5-Macrogroup	Great Plains Mixedgrass Prairie Grassland and Shrubland
Level 6-Group	Mixed Dry Grassland
Lower	
Level 7-Alliance	Little Bluestem-Sideoats grama Herbaceous Alliance
Level 8-Association	Little Bluestem-Sideoats Grama-Blue Grama-Threadleaf Sedge Herbaceous Vegetation

Table 2. Natural vegetation hierarchy with common name examples.

Cultural Vegetation

The cultural vegetation hierarchy is also composed of eight classification levels in three hierarchical tiers. All levels of the hierarchy are primarily defined by varying degrees by physiognomic and floristic criteria, but are assessed in the context of the anthropogenic activities that govern these properties. All type descriptions should be derived from field observations in which the crop or managed species, growth forms, their abundance, overall vegetation structure, and habitat setting are described. However, other sources of information, such as analysis of imagery and thematic spatial data layers may also be used.

The cultural vegetation hierarchy varies from the natural vegetation hierarchy in that it provides an additional physiognomic level and places less emphasis on broad-scale, biogeographic and climate patterns. The eight levels compromising the cultural vegetation hierarchy of the NVC are described below.

Upper-level units:

The upper-level units consist of four classes defined on the basis of physiognomic and ecological factors.

1. **Cultural Class**: A characteristic combination of dominant growth forms adapted to relatively intensive anthropogenic manipulations, as reflected in relatively rapid changes in structure and/or composition.

2. **Cultural Subclass**: A combination and degree of herbaceous versus woody growth.

3. **Cultural Formation**: Dominant growth form of the canopy structure and whether annually converted or heavily manipulated/harvested.

4. **Cultural Subformation**: The spatial structure of the vegetation and degree of manipulation of the canopy.

Middle-level units:

The middle-level units consist of two classes defined on the basis of a combination of physiognomic and floristic factors.

5. **Cultural Group**: A common set of growth forms and many diagnostic plant taxa sharing broadly similar region and climate and disturbance factors.

6. **Cultural Subgroup**: A common set of growth forms and diagnostic species preferentially sharing a similar set of regional edaphic, topographic, and disturbance factors.

Lower-level units:

The lower-level units consist of two classes, one of which is optional, defined on the basis of floristic factors.

7. **Cultural Type**: One or more dominant or co-dominant species, as well as habitat conditions and physiognomy.

8. **Cultural Subtype** (optional): One or more dominant or co-dominant species in conjunction with a characteristic set of associated species, habitat conditions, and physiognomy.

Table 3 shows the eight hierarchical levels of the cultural vegetation classification and provides common name examples for each.

Cultural Vegetation Hierarchy	**Example**
Upper	
Level 1-Cultural Class	Agricultural Vegetation
Level 2- Cultural Subclass	Herbaceous Agricultural Vegetation
Level 3- Cultural Formation	Cultivate Crop
Level 4- Cultural Subformation	Row Crop
Mid	
Level 5-Cultural Group	Temperate Row Crop
Level 6-Cultural Subgroup	Corn
Lower	
Level 7-Cultural Type	Sweet Corn
Level 8-Cultural Subtype (optional)	

Table 3. Cultural vegetation hierarchy with common name examples.

3.4 Implementing the National Vegetation Classification: Natural Vegetation

Data Sources

The vegetation types of the natural vegetation hierarchy may be derived from two sources of information: scientific literature and field plot data, with a preference on the latter. The goal is that the NVC will eventually be based entirely on, and linked to, publicly available plot data and all vegetation types are described from quantitative analysis of field data. In order to expedite the

development of the NVC, though, vegetations types derived from existing scientific literature are permissible.

Collecting Field Plot Data

The NVC is predicated on the notion that field data must be collected and archived in a consistent manner and are publicly available. This requires an adherence to plot design and data collection parameters for so-called classification plots, i.e. plots used for the derivation of vegetation types. For plots documenting previously defined vegetation types, so-called occurrence plots, less information is required.

1. *Stand selection and plot design:*

   A plot should represent a relatively homogenous unit of vegetation and should be large enough to represent the stand in terms of total species composition and abundance. Criteria used to select stands should be thoroughly documented.

2. *Species composition of the plot*

   Levels 4 through 8 of the hierarchy require the identification of genera, species, and finer taxa of a plot. The identification of plant taxon consists of a name and a dated taxonomic reference or an explicit statement that the reference is unknown.

   The complete assemblage and abundance of vascular plant species in a stand is required for classification plots. Recording of nonvascular plants is required where nonvascular plants are dominant. Each species listed in a plot should be assigned to either a stratum or a growth form (see below). Estimates of abundance for each stratum or growth form are also required.

   The minimum requirements for occurrence plots are: dominant taxa names (and references, if available); measure of abundance of recorded taxa; geographic coordinates of plot; observer name(s) and date of observation.

   Plots need only be sampled once at the appropriate time of the year. However, recurrent sampling can improve sampling quality and is recommended for vegetation types with marked phenological variation.

3. *Vertical structure and physiognomy of the plot:*

   Levels 1 through 3 of the hierarchy require a description of the structure and physiognomy of the vegetation, the canopy cover of the major growth forms (Table 4; Figure 1), and strata or layers (Table 5; Figure 2) in which the types occur. There are two equally permissible approaches to defining the upper levels: First describe growth forms, then subdivide these into size classes or describe the strata first, then subdivide the strata growth forms.

   Each plant in the plot is assigned to stratum based first on its height and second by its growth form. While each individual plant is to be assigned to a single stratum, a tree species may be listed in several strata, for example, in the instance when a tree species has both seedlings and saplings in a stand.

   The canopy cover of each stratum is the total vertical projection on the ground of all species in that stratum, not the sum of individual covers of each species in a stratum. Additionally, the percent cover at least three of the most abundant growth forms in each stratum should be estimated.

Epiphytes and liana should be included in the stratum in which they occur, while bryophytes and lichens growing on the same substrate as vascular plants are treated as nonvascular strata. This nonvascular stratum is reserved exclusively for mosses, lichens, liverworts, algae, and bacteria, even if herbs or woody plants are reduced to very short heights.

General Growth Form	Description
Trees	Woody plants, usually with a single main stem and a definite crown. In instances where growth form can not be determined, mature woody plants greater than 5 m in height shall be considered trees.
Shrubs	Woody plants that exhibit several erect, spreading, or prostate stems that give a bushy appearance. In instances where growth form can not be determined, mature woody plants less than 5 m in height shall be considered shrubs.
Herbs	Nonvascular plants without significant woody tissue above the ground, with penetrating buds borne at or below the ground surface.
Nonvascular	Plant or plant-like organism without xylem and phloem (e.g. mosses, liverworts, lichens, and algae).
Floating	Rooted or drifting plants that float on the water surface
Submerged	Rooted or drifting plants that by-and-large remain submerged in the water column or on the aquatic bottom
Epiphyte	Vascular or nonvascular plant that does not root in the ground, but grows by germinating and rooting on other plants or structures
Liana	A woody climbing plant that relies on external structural support for height growth during part of its life. Typically exceeds 5 m in height or length at maturity

Table 4. General growth forms and their description. After (Tart *et al*. 2005).

Figure 1. Examples of common general growth forms. Adapted from the Fish and Wildlife Service.

Stratum	Description
Tree Stratum	Vegetation layer in which woody plants are typically greater than 5 meters in height. Includes mature trees; shrubs over 5 meters in height; epiphytes, and lianas.
Shrubs Stratum	Vegetation layer where woody plants are typically between 0.5 m and 5 m in height. Includes shrubs, tree samplings, lianas, and epiphytes, but excludes rooted herbaceous vegetation over 0.5 m in height.
Field (Herb) Stratum	Vegetation layer consisting of herbs, regardless of height, and woody vegetation less than 0.5 m in height.
Nonvascular Stratum (Ground)	Vegetation layer consisting of nonvascular plants growing on soil or rock surfaces.
Floating Stratum	Vegetation layers in which rooted or drifting plants float on the water surface.
Submerged Stratum	Vegetation consisting of rooted or drifting plants that by-and-large remained submerged in the water column or on the aquatic bottom.

Table 5. General vegetation strata and their description. After Jennings *et al*. 2006.

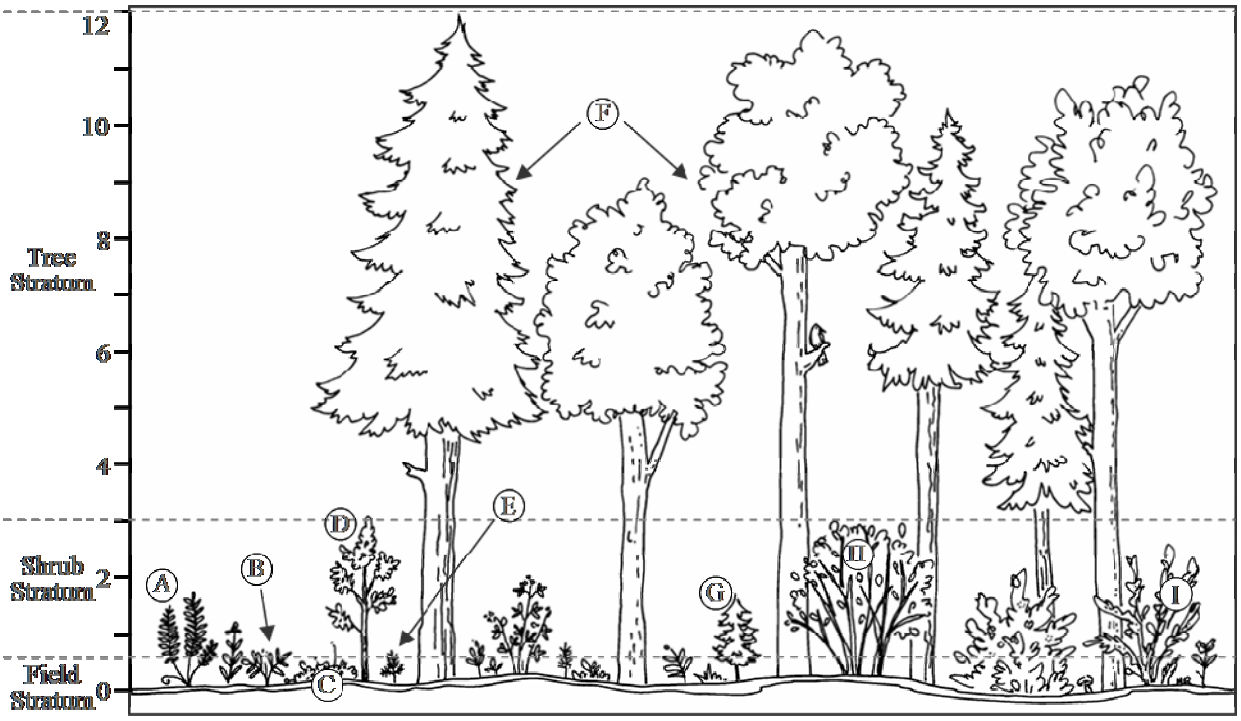

Figure 2. General vegetation strata. Source: FGDC (2008).

4. *Physical data of the plot:*

   Because physical variables widely vary across the range of vegetation types, there are no absolute minimums set for specific environmental criteria. Rather, the following are variables which should be considered for use in describing the vegetation plot:

   a. Stand physical features, such as elevation (in meters), slope gradient (in degrees or percent), and slope aspect (in azimuth degrees), landform, topographic position, and geologic parent material.

b. Where appropriate, water and soil features, including depth of water, water salinity, soil moisture, and drainage.

c. Soil surface characteristics, including the percent of litter, rock, bare ground, coarse woody debris, vascular and non vascular plant cover, and surface water.

d. General vegetation characteristics, including landscape context, successional status, evidence of disturbance, phenological phase, stand maturity, and homogeneity of the vegetation.

5. *Geographic data for the plot:*

Locational information for plots should be recorded in a standard format. For historical data in which geographic information was recorded differently, the original information should be preserved and the data should be transformed into the standard format. The transformation method should be described and reproducible. The following information is required (also see Table 6):

a. Longitude and latitude in decimal degrees using WGS 84 (NAD 83) datum. Record the coordinates and datum that were collected in the field. If a nonstandard map projection is used, record the projection name, spatial units, sphreroid, central meridian, latitude of projection origin, and any other relevant information such as false easting and northings.

b. Description of the method used to determine plot location (e.g. GPS; estimated from USGS topographic map). If estimated using a USGS quadrangle, include a narrative that describe the quadrangle name and how the location estimated.

c. An estimate of the accuracy of the plot location in the form of radius in meters, preferably for 95% certainity.

d. Any other narrative information that will aid in plot relocation.

Attribute Name	**Attribute Definition**
Longitude & Latitude	Longitude and Latitude of plot origin in decimal degrees using WGS84 (NAD83) datum following any adjustments, conversions, or differential correction.
Type of Field Coordinates	Coordinates recorded in the field, including projection name, datum, spheroid, central meridian, latitude of origin, and false easting and northing.
Location Accuracy	Estimated accuracy in meters in which plot origin has 95% or greater probability of being within this reported distance.
Area	Total area of plot (m^2). If subplots used, includes total area of subplots and the interstitial space.

Table 6. Required geographic data for a plot.

6. *Metadata for the plot:*

Metadata for plots is essential. All plots should have a project name and associated description, methods used for plot selection and layout, level of effort expended in gathering floristic data, cover scale and strata used, and the name and contact information of the lead field investigators.

The following information is required metadata for plots (also see Table 7):

a. An author plot code

b. An author observation code (for multiple observations at same plot over time)

c. Date and date accuracy of observation.

d. Name of lead field investigator.

e. Plot selection approach.

f. Characteristics of plot.

   i. Area in m^2

   ii. Plot type, indicating whether observations made in entire plot of using subplots

   iii. If subplots used, indicate total observation area of subplots

   iv. If subplots use, indicate how subplots distributed in the plot

g. Cover or abundance methodology for species composition, growth form, or strata.

Attribute Name	**Attribute Definition**
Author Plot Code	Plot number or code
Author Observation Code	Code or number used to identify an individual observation of a particular plot. If a plot only has one observation, the observation code and plot code may be identical
Observation Start Date	Date of the observations, or the first day of observation if spanned multiple days
Date Accuracy	Estimated accuracy of observation date (often low for historic data)
Name of Lead Investigator	First name and surname of primary individual that made observation
Characteristics of plot	Total area of plot (m^2). Indicate if information recorded in entire plot or subplots. If subplots, indication of how subplots were configured (e.g. contiguous, regular, or random)
Cover Dispersion	Indication of how cover values for total taxa list were collected

Table 7. Required metadata for a plot.

Use of Literature or Other Data Sources

In instances in which plot data are unavailable or available in limited number, published literature and other documentation may be used as a data source to describe vegetation types. The use of literature to describe types should be limited to instances in which the literature describes a type that is no longer available to be described across its historic range or in regions in which the NVC is weakly developed and the literature provides information not otherwise available. Additionally, there may be instances in which plot data are not readily available, but the data have been carefully summarized in a tabular description. As long as these data meet minimum standards, they may be used to describe a vegetation type. In instances in which such ancillary data are used, an estimate of the confidence in the data should be included.

Data Management and Dissemination

In order for the NVC to be successful, careful and explicit data management rules must be followed. Three dynamic and interdependent datasets are required: a. botanical taxonomy and nomenclature; b. vegetation field plots; and c. classified alliance and associations. These are described below.

a. *Taxonomic Dataset*

   Each recorded taxon should be recorded as a name-and reference couplet; unknown taxa should be reported at the finest taxonomic level with certain identification and should be accompanied with a note field containing additional information; floristic units will be classified by cross-walking taxonomic names and concepts; and growth form names and concepts used to describe vegetation should be based on a specified reference and contain a clear definition.

b. *Plot Dataset*

   Plot data should be stored in publicly available and searchable databases, such as VegBank (www.vegbank.org); should site the original author of the plot; use concept-based taxonomy; and datasets should have assured data permanency and should be exportable in a format consistent with the NVC.

c. *Vegetation Classification Dataset*

   All fields needed for type descriptions are required; at a minimum, each type name requires a citation; and the datasets shall allow backward compatibility as vegetation type concepts and names change over time.

All dataset must be publicly accessible and searchable via a primary access point on the web and should be regularly updated. The website is to contain an explicit date and version to ensure users can properly cite the website and version observed.

3.5 Implementing the National Vegetation Classification: Cultural Vegetation

Data Sources

Cultural vegetation types can be derived from a number of different sources: analysis of imagery, thematic spatial data layers, and field survey data. The finer levels of the classification hierarchy, though require more detailed data. Standards for vegetation sampling methods for cultural vegetation are forthcoming. In the meantime, standard sampling methods, including those utilized by the classification of natural vegetation, should be followed and documented.

The development of a comprehensive list of the nation's cultural vegetation types is an ongoing process. A preliminary list of cultural vegetation types is available in the *National Vegetation Classification Standard, Version 2* in Appendix 1.

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