Guide to the National Vegetation Classification Standard (Version 2)

What is the National Vegetation Classification Standard (Version 2)?

The National Vegetation Classification Standard, Version 2 (hereinafter NVC) was developed to establish a national set of standards for classifying existing vegetation. This will facilitate inter-agency collaboration and inter-agency vegetation map product consistency. It will also foster accuracy, consistency, and clarity in the structure, labeling, definition and application of vegetation for the United States. The NVC also defines and adopts standards for vegetation data collection and analysis.

The NVC (version 2) was revised in February 2008 and is being implemented by various federal, state, tribal, and non-profit agencies and as well as academic researchers and private environmental consulting firms who see the value in sharing vegetation data among other agencies and groups. Currently, the National Park Service Inventory and Monitoring Program uses the NVC to guide vegetation mapping. The US Forest Service Existing Vegetation Classification and Mapping Technical Guide (Version 1) was developed in tandem with the NVC.

Some of the objectives and goals of the NVC are:

° Develop a scientific, standardized classification system, with practical use for conservation and resource management.

° Classify existing vegetation. Existing vegetation is the plant cover, or floristic composition and vegetation structure, documented to occur at a specific location and time, preferably at the optimal time during the growing season.

° Classify vegetation on the basis of inherent attributes and characteristics of the vegetation structure, growth form, species and cover, emphasizing both physiognomic and floristic criteria.

° Base criteria for the types on ecologically meaningful relationships, i.e., abiotic, geographic and successional relationships.

° Organize types by a hierarchy. The NVC is hierarchical with a small number of generalized types at the higher level and an increasingly large number of more detailed types at the lower levels. Having multiple levels allows for applications at a range of scales.

° Base the upper levels of the NVC are based primarily on the physiognomy (growth

form, cover, structure) of the vegetation (not individual species). Lower levels are based primarily on floristics (species composition and abundance), and mid levels are based on a combination of vegetation criteria.

° Describe types based on plot data, using publicly accessible data wherever possible.

° Modify the classification through a structured peer review process. The classification standard is intended to be dynamic, allowing for refinement as additional information becomes available.

° Facilitate linkages to other classifications and to vegetation mapping (but the classification is not a map legend).

Links to the NVC (2) Standard in its entirety

To view the NVC Version 2 in its entirety, see:

http://www.fgdc.gov/standards/projects/FGDC-standards-projects/vegetation/NVCS_V2_FINAL_2008-02.pdf

Who Is Required to Use the NVC?

All federal agencies engaged in the classification of vegetation are required to crosswalk to the NVC. **All institutions, non-profit organizations or individuals receiving federal funds are also expected to use the NVC.** All federally funded projects collecting vegetation data can share their data and mapping products among one another, to facilitate better resource management and conservation efforts between federal and non-federal groups. Because of this national level need to combine efforts and share data, individuals and non-federally funded agencies and groups are also encouraged to use the NVC.

All vegetation mapping and inventory units developed using federal funds should crosswalk to the NVC. This means that the composition of any map unit or inventory unit should be described in terms of one or more vegetation types at an appropriate level of the NVC hierarchy. For example, individual plots should be assignable to one vegetation type at the lowest possible level of the NVC hierarchy. Local vegetation types and map units may crosswalk to one or more NVC vegetation types at a similar level of the NVC hierarchy. So, all federal agencies (or others using federal funds) should provide the minimum data needed to integrate plot data and crosswalk vegetation types and map units to the NVC.

The crosswalking requirement applies to:

Vegetation plot data
Vegetation types (taxonomic units)

Vegetation map units

Who Can Use the NVC?

Anyone using vegetation classification for mapping purposes or collecting vegetation field data can use the NVC standard. The NVC vegetation data plot protocol is fairly basic; all protocol components are used universally in vegetation monitoring projects. Therefore, implementing the NVC standards does not impede the ability of individual users to add additional specific criteria for data collection.

We have included a comprehensive glossary of terms at the end of this guide for individuals who are new to vegetation classification and data collection terminology. By becoming familiar with the terminology, first time users can understand the NVC content and standards more effectively.

Advantages and Limitations of the NVC

The goal behind the NVC (Version 2) was to create a more ecologically meaningful classification that can be utilized and linked (i.e., crosswalked) to existing agency-specific classification systems. Nationwide adoption of a single vegetation classification system is crucial in modeling vegetation-environment interactions. Currently, there is a strong drive to model local, regional and global vegetation changes in response to global climate change, particularly changes in temperature, precipitation and disturbance regimes. Furthermore, the NVC will facilitate conservation and management efforts among agencies and their partners. The NVC is not intended to replace agency specific classification systems. Instead, the NVC classification protocol is still broad enough that agencies can still use their own classification systems to suit their specific needs and link their data directly to a hierarchy level within the NVC.

Advantages of the NVC are:

- The NVC can be used to compare and help combine differing map products.
- The NVC can help inform the design of map legends at multiple scales for a variety of purposes.
- The NVC can assist federal agencies and their partners (such as academic researchers and non-profit organizations) to cooperate more effectively in vegetation resource conservation and management.
- By combining and crosswalking existing vegetation classification systems, the NVC will provide critical reference points for monitoring the response of vegetation and community dynamics to climate change at local and regional levels, which can be shared with similar international efforts.

- The NVC will also allow for the sharing of past vegetation or community level research data among agencies and partners. This can help direct additional vegetation or species-specific research.

- The newest version of the NVC (2) hierarchy has been developed to be more ecologically meaningful.

- The NVC was developed to foster movement towards a single U.S. classification system for existing vegetation. In the long term, this will save money and time and allow for ease of sharing vegetation data among agencies and partners.

It should be emphasized that the NVC is not synonymous with a map legend. However, it can be used as a tool for development and refinement of map legends, so that better maps are produced and can be shared in the future. Because the NVC is a dynamic classification system that will continue to be refined periodically, it is not a final, rigid protocol or product for vegetation classification. Consequently, all agencies and partners will need to remain current to any future revisions and refinements of the NVC. They may have to adjust their mapping efforts, data submission, and use of hierarchy levels in describing vegetation, particularly at the middle and lower levels of the hierarchy.

Frequently asked questions about the NVC

1. If I use the NVC, how will it affect my data collection methods or vegetation classification efforts? The NVC does not replace specific classification approaches and systems that address particular management needs such as inventory, monitoring, and mapping and targeting specific management applications.

2. Why is it so important to crosswalk existing classification systems to the NVC? By becoming familiar with NVC hierarchy, agencies can crosswalk their vegetation classification systems to middle and lower levels on the NVC hierarchy, rather than to the upper level hierarchy, such as formation (Levels 1 to 3). Crosswalking to the middle and lower levels is necessary to refine and improve map products and to facilitate data sharing among agencies and partners. For example, ecological systems –a classification developed by NatureServe and used as LandFire and ReGAP mapping units-- can be nested to the Macrogroup (Level 5), Group (Level 6) and Alliance (Level 7) levels of the new NVC hierarchy.

3. How will existing and future vegetation related data be linked to the NVC? By using the NVC data collection protocol, individuals and agencies will be able to load their data to a publicly available database, such as VegBank (www.vegbank.org); to allow for referencing and sharing of data.

4. How often will the NVC classification be revised? The NVC classification standard is subject to periodic peer review as additional information on the use and application of the NVC becomes available. On average, the peer review process occurs every 2 to 3 years**.**

5. Can the NVC be used to map or classify potential natural vegetation? No. The NVC does not directly apply to the classification or mapping of potential natural vegetation, only existing natural vegetation.

Summary of NVC Standards

- **Inventory and plot standards**: to establish criteria for the collection of vegetation plot data, the purpose of field sampling, and the standards for vegetation plot data.
- **Standards for the documentation and characterization of vegetation units**: to formalize a standard format for documentation, characterization, and review in support of recognized units in the classification system.
- **Nomenclature standards**: based on the scientific names of the diagnostic (dominant, differential, indicator, or character) species and follow NVC nomenclature standards;
- **Standards for data management (dissemination and archiving)**: to establish an overall system for data management, archiving, and dissemination.

These standards are for classification of existing (not potential) vegetation and are based upon vegetation condition at the optimal time during the growing season. The vegetation types are defined on the basis of species composition within types. The standards are for vegetation classification, not landscape, ecosystem, or site classification. The classification will include the full range of plant communities, including both natural and semi-natural vegetation and cultural (anthropogenic crops) vegetation.

Summary of the National Vegetation Classification Standard Hierarchy

The NVC standard is a hierarchical system designed to classify existing vegetation (i.e. plant cover, floristic composition, and vegetation structure occurring in a specific place at a specific time) on the basis of both physiognomic and floristic criteria. The upper levels of the classification are physiognomic, defined primarily on the basis of 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 standard encompasses all areas having 1% or more of their surface area covered with live vegetation. Non-vegetated lands and open water are excluded.

The first break in the NVC hierarchy is between natural and cultural vegetation, with separate classification hierarchies for each type (Table 1). Natural (and semi-natural) vegetation is defined as vegetation in which species and site characteristics are determined primarily by ecological processes. This also includes plant communities altered by fire management,

vegetation restoration and reforestation practices. Natural vegetation may be influenced to varying degrees by human activity. Vegetation that has been shaped by both anthropogenic disturbances and ecological processes (e.g., old fields) is defined as semi-natural vegetation. Cultural vegetation has a structure, composition, and development determined by regular human activity, such as land clearing and agricultural management of agronomic and horticultural vegetation (crops).

NVC Hierarchy	Natural Vegetation	Cultural Vegetation
Upper Level		
	Level 1-Formation Class	Level 1- Cultural Class
	Level 2- Formation Subclass	Level 2- Cultural Subclass
	Level 3- Formation	Level 3- Cultural Formation
		Level 4- Cultural Subformation Row Crop
Mid Level		
	Level 4-Division	Level 5-Cultural Group
	Level 5-Macrogroup	Level 6-Cultural Subgroup
	Level 6-Group	
Lower Level		
	Level 7-Alliance	Level 7- Cultural Type
	Level 8-Association	Level 8- Cultural Subtype (optional)

Table 1. National Vegetation Classification Hierarchy.

Natural Vegetation

The natural vegetation hierarchy is composed of eight classification levels in three tiers (upper, mid, and lower). All levels of the hierarchy are primarily defined to 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, location 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 vegetation hierarchy uses five criteria to classify vegetation: 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 and criteria comprising the natural vegetation hierarchy of the NVC are summarized in Table 2 and further described in detail below.

NVC Hierarchy	Natural Vegetation Hierarchy	Criteria for Natural Vegetation
Upper Level		
		Vegetated (1% or greater) vs. Non-vegetated
		Natural vs. Cultural vegetation
	Level 1-Formation Class	Growth form →← Moisture-Temperature
	Level 2- Formation Subclass	Growth form →← Global climate
	Level 3- Formation	Growth form response to continental climate, topography, soils.
Mid Level		
	Level 4-Division	Biogeographic species groups similar in response to continental climate
	Level 5-Macrogroup	Biogeographic species groups similar in response to regional climate.
	Level 6-Group	Biogeographic species groups similar in response to regional climate & soils
Lower Level		
	Level 7-Alliance	Species mostly in the dominant layer
	Level 8-Association	Species in all layers 2 to 3

Table 2 Summary of Criteria for Natural Vegetation Classification within the NVC Hierarchy.

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 corresponding 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 three mid-level units are defined on the basis of both physiognomic and floristic characteristics.
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, substrates, 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 layer 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.

Examples of the NVC Natural Vegetation hierarchy with an upland and wetland community are illustrated in Table 3.

Natural Vegetation Hierarchy	Example: Upland	Example: Wetland
Upper Level		
Level 1-Formation Class	Forest and Woodland	Shrubland and Grassland
Level 2- Formation Subclass	Temperate Forest	Temperate and Boreal Shrubland and Grassland
Level 3- Formation	Cool Temperate Forest	Temperate Boreal Bog and Fen
Mid Level		
Level 4-Division	Western North America Cool Temperate Forest	North American Bog and Fen
Level 5-Macrogroup	Northern Rocky Mountain Lower Montane and Foothill Forest	Western North America Bogs and Fen
Level 6-Group	Northern Rocky Mountain Ponderosa Pine Woodland and Savanna	Rocky Mountain Subalpine-Montane Fen
Lower Level		
Level 7-Alliance	Ponderosa Pine-Douglas-fir Woodland Alliance (*Pinus ponderosa- Pseudotsuga menziesii* Woodland Alliance)	Inflated Sedge Seasonally Flooded Herbaceous Alliance Inflated Sedge Herbaceous Alliance (*Carex utriculata/Carex rostrata* Herbaceous Alliance)
Level 8-Association	Ponderosa Pine-Common Snowberry Forest (*Pinus ponderosa-Symphoricarpos albus* Forest)	Northwest Territory Inflated Sedge Herbaceous Vegetation (*Carex utriculata* Herbaceous Vegetation)

Table 3: NVC Natural vegetation hierarchy with community common name examples (scientific name in parenthesis).

IMPORTANT NOTE: The NVC uses the USDA PLANTS database (http://plants.usda.gov/) for currently accepted scientific names and common names per taxon as well as taxonomic references and synonyms.

Cultural Vegetation

The cultural vegetation hierarchy consists of eight classification levels in three tiers. All levels of the hierarchy are primarily defined 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, abundance, overall vegetation structure, and habitat setting are described. The cultural vegetation

hierarchy differs from the natural vegetation hierarchy in that it provides an additional physiognomic level and places less emphasis on broad-scale biogeographic and climatic patterns. The lowest level, cultural subtype, is optional. The cultural vegetation NVC hierarchy is described below and illustrated in Table 4.

Upper-level units (Levels 1 to 4):

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.

Cultural Vegetation Hierarchy	Example	Example
Level 1- Cultural Class	Agricultural Vegetation	Agricultural Vegetation
Level 2- Cultural Subclass	Herbaceous Agricultural Vegetation	Woody Agricultural Vegetation
Level 3- Cultural Formation	Cultivated Herbaceous Crop	Cultivated Woody Crop
Level 4- Cultural Subformation	Row Crop	Orchard
Level 5-Cultural Group	Temperate Row Crop	Temperate Orchard
Level 6-Cultural Subgroup	Wheat	Fruit-Orchards
Level 7- Cultural Type	Winter Wheat	Cherry
Level 8- Cultural Subtype (optional)		

Table 3: NVC Cultural Vegetation Hierarchy Example with common name example.

Implementing the National Vegetation Classification: How to do a vegetation plot using NVC version 2.

The NVC vegetation plot protocol is fairly basic; all protocol components are used universally in vegetation monitoring projects. Therefore, implementing the NVC standards does not impede the ability of users to add additional management specific criteria for data collection. In all vegetation monitoring projects, the basic components of data collection include:

- A stand must be selected to represent community
- The plot must capture species diversity and abundance
- The general structure found in the community must be characterized.
- Geographic data must be recorded in order to relocate the plot.
- Basic information should identify date measured, observers, plot type and size.
- Physical attributes (slope, elevation, aspect, hydrology, parent material, soils) of the plot's location are added in order to fully interpret data results.

Vegetation monitoring may differ among users, however, in the methodology used to capture species composition, abundance and structure

Data Sources

One of the goals of the NVC is to base a nationally utilized classification system on publicly accessible vegetation plot data. Furthermore, the NVC mandates that all vegetation types are

accurately described from quantitative analysis of field data. Data sources can be from two sources: field plot data (priority) or existing scientific literature. Using existing scientific literature is permissible as a secondary option in cases where no field plot data exists.

NVC Protocol for Collecting Field Plot Data

The NVC requires that field data must be collected and archived in a consistent manner and be publicly available. This requires adherence to plot design and data collection standards. Two types of plots are recognized: classification plots, which are used for the derivation of vegetation types; and occurrence plots, for documenting previously defined vegetation types. This section describes the types of information that must be collected in the field.

1. Stand selection and plot design:
A plot should be established in a relatively homogenous unit of vegetation and be of sufficient size to represent the total species composition and abundance of the stand. Criteria used to select stands should be thoroughly documented. A plot can be either a single, large comprehensively sampled plot (Macroplot) or a set of sub-sampled areas (Microplots) within a larger plot.

2. Species composition of the plot

Species composition is required for defining units in Nomenclature and Identification: Hierarchy levels 4 through 8. The floristic composition consists of both the identity and the abundance of the genera, species and finer taxa occurring within the plot. The identification of a plant taxon consists of a name and a dated taxonomic reference or, if unknown, an explicit statement that the reference is unknown.

For classification plots, sampling must be designed to detect and record the complete abundance and assemblage of vascular plant species in the stand. Recording nonvascular plants is required where nonvascular plants are dominant.

For classification plots, cover is the required measure of species abundance. Thus, measurement of canopy cover is preferred to measurement of foliar cover. For cover values that are discreet rather than continuous, cover scales should be defined quantitatively and fit within Braun-Blanquet or similar scheme of cover classes.

For occurrence plots, the minimum requirements are: dominant taxa names (and references, if available); cover values (or another 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 data quality and is recommended for vegetation types with marked phenological variation. Each species listed in a plot should be assigned to either a stratum or a growth form. Estimates of abundance for each stratum or growth form are also required.

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 5), and strata or layers in which the types occur. There are two 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 a 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, e.g., when a tree species has both seedlings and saplings in a stand.

Epiphytes and lianas 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	Vascular plants without significant woody tissue above the ground, with penetrating buds borne at or below the ground surface.
Nonvascular Plant	Plant-like organism without xylem and phloem (e.g. mosses, liverworts, lichens, and algae).
Floating	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.

General Growth Form	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.
Shrub 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.
Herb Stratum	Vegetation layer consisting of herbs, regardless of height, and woody vegetation less than 0.5 m in height.
Nonvascular Plant 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

Tables 5 & 6: General vegetation descriptions, vegetation strata and their description.

4. Physical data of the plot:

Because physical features vary widely across the range of vegetation types, there are no absolute minimum requirements set for specific environmental criteria. Instead, the following are features that should be strongly considered for inclusion in describing the vegetation plot:

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.

Water and soil features, including depth of water, water salinity, soil type, soil moisture, and drainage.

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

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

5. Geographic data for the plot:

Location 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 data should be transformed into the standard format. The transformation method should be described and reproducible.

The following geographic data is required:
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 was estimated.
c. An estimate of the accuracy of the plot location in the form of radius in meters, preferably for 95% certainty.
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.

Table7: 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:

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 used, 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 (m2). 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 taxon list were collected

Table 8: Required metadata for a plot.

Use of Literature or Other Data Sources

In instances in which plot data are unavailable or available only in limited amount, 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 cases 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. In some cases, plot data may not be readily available, but the data have been carefully summarized in a tabular description. As long as data meet minimum NVC standards, they may be used to describe a vegetation type. When 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.

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 crosswalking taxonomic names and concepts; growth form names and concepts used to describe vegetation should be based on a specified reference and contain a clear definition. For currently accepted scientific binomials and references, see the USDA PLANTS database (http://plants.usda.gov/).

IMPORTANT NOTE: Nomenclature is constantly being updated and revised. It is important that users periodically revisit the USDA PLANTS DATABASE to keep current with the ever-changing taxonomic revisions.

Plot Dataset

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

Vegetation Classification Dataset

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

All datasets 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.

Implementing the NVC: 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, however, require more detailed data. Standards for vegetation sampling methods for cultural vegetation have not yet been fully developed at this time. In the interim, standard sampling methods, including those utilized by the classification of natural vegetation, should be followed and documented.

At this time, 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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Glossary of Terms

Abundance- total number of individuals of a taxon in an area, population or community, often measured as canopy cover in plants.

Agricultural Vegetation- a vegetation type that exhibits rapid turnover in structure, often on an annual basis, either through manipulation of the physiognomy and floristics by harvesting and/or planting, or by continual removal of above ground structure (cutting, haying) or by strong linear planted features. Area can be bare at certain times of the year.

Alliance- a lower level of classification in the NVC hierarchy that describes 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 layer and reflecting regional to subregional climate, substrates, hydrology, moisture/nutrient factors, and disturbance regimes. An alliance consists of one or more associations.

Association- the lowest level (Level 8) in the NVC hierarchy that describes a characteristic range of species composition, diagnostic species occurrence, habitat conditions, and physiognomy reflecting topo-edaphic, climate, substrates, hydrology, and disturbance regimes

Author - the author who first described the recognized species or finer taxa. In the NVC, the author must be recorded. A given taxa may be described by one author, whereas the finer taxa (subspecies or variety) may have been recognized and described (usually at a later date) by another author. Example: *Pinus ponderosa* **P.C. & Lawson** var. *scopulorum* **Engelmn.**

Biogeography- is the study of the distribution of biodiversity over space and time, to reveal where organisms live, and at what abundance

Character species- a species that shows a maximum concentration, quantitatively and by constancy, in one defined vegetation type; sometimes recognized at local, regional and general geographic scales.

Community- a group of plant species living together and linked together by their effects on one another and their responses to the environment they share. Typically, plant species that co-occur in a plant community show a definite association or affinity with each other.

Constant species- species present in the highest percentages of the plots that define a vegetation type, often defined as those species with at least 60% constancy.

Crosswalk- term used to describe and document the relationships between members of one set of series. Those relationships can be one to one, one to many, or many to many. In vegetation mapping it refers to linking a specifically classified or defined vegetation type or community to another.

Cultural Class- a cultural vegetation classification unit of high rank (Level 1) defined by a characteristic combination of dominant growth forms adapted to relatively intensive human manipulations, as reflected in relatively rapid changes in structure and composition.

Cultural Subclass- a cultural vegetation classification unit of high rank (Level 2) defined by combinations and degree of herbaceous and woody growth forms.

Cultural Formation- a cultural vegetation classification unit of high rank (Level 3) defined by whether or not canopy structure of dominant growth forms is annually converted or heavily manipulated or harvested.

Cultural Subformation- a cultural vegetation classification unit of intermediate rank (Level 4) defined by spatial structure of the vegetation, including whether in swards, rows, and degree of manipulation to the canopy.

Cultural Group- a cultural vegetation classification unit of intermediate rank (Level 5) defined by a common set of growth forms and many diagnostic plant taxa sharing a broadly similar region and climate, and disturbance factors.

Cultural Subgroup- a cultural vegetation classification unit of intermediate rank (Level 6) defined by a common set of growth forms and many diagnostic and plant taxa preferentially sharing a similar set of regional, edpahic, topographic, and disturbance factors.

Cultural Type- a vegetation classification unit of low rank (Level 7) defined by one or more dominant or co-dominant species, as well as habitat (cultivated) conditions, and physiognomy.

Cultural Subtype- a vegetation classification unit of the lowest rank (Level 8) defined by one or more dominant or co-dominant species, in conjunction with a characteristic set of associated species, habitat (cultivated) conditions and physiognomy.

Cultural Vegetation- vegetation with distinctive structure, composition, and development determined by regular human activity.

Division- a NVC classification unit of intermediate rank (Level 4) that describes 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.

Dominant growth form- a growth form with the highest percent of cover, usually in the uppermost canopy layer.

Differential species- a plant species that is distinctly more widespread or successful in a pair or group of plant communities than in others; although it may be still more successful in other communities not under consideration. The more limited a species is to one or a few community types, the stronger its differential value.

Dominant species- species with the highest percent of cover, usually in the uppermost canopy layer.

Epiphyte- vascular or nonvascular plant that does not root in the ground, but grows by germinating and rooting on other plants or structures.

Existing Vegetation-vegetation existing on a particular site at the time of observation.

Floating Stratum- vegetation layers in which rooted or drifting plants float on the water surface.

Formation- a NVC classification unit of highest rank (Level 1) that describes a broad combination of dominant general growth forms that correspond to global moisture and temperature regimes and/or substrate or aquatic conditions.

Formation class- a NVC classification unit of high rank (Level 2) that describes a broad combination of dominant general growth forms that correspond to global moisture and temperature regimes and/or substrate or aquatic conditions.

Formation subclass- a NVC classification unit of high rank (Level 3) that describes a combination of general dominant and diagnostic growth forms reflecting global macroclimatic factors including by elevation, seasonality of precipitation, and soil moisture conditions**.**

Genera (plural)/Genus (singular)- a taxonomic subdivision between a plant family and species, which includes one or more closely related species. Compare species.

Group- a NVC vegetation classification unit of intermediate rank (Level 6) that describes 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, substrates, hydrology, and disturbance regimes

Herb- vascular plants without significant woody tissue above the ground, with penetrating buds borne at or below the ground surface.

Herb Stratum- vegetation layer consisting of herbs, regardless of height, and woody vegetation less than 0.5 m in height.

Indicator growth form- a growth form whose presence, abundance, or vigor is considered to indicate certain climatic and site conditions.

Indicator species- a species whose presence, abundance, or vigor is considered to indicate certain climatic and site conditions.

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.

Macrogroup- a NVC vegetation classification unit of intermediate rank (Level 5) that describes 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.

Natural Vegetation- is defined as vegetation in which species and site characteristics are determined primarily by ecological processes.

Nonvascular Plant- plants that lack vascular tissue such as mosses, liverworts, hornworts, lichens and algae.

Nonvascular Plant Stratum- vegetation layer consisting of nonvascular plants growing on soil or rock surfaces.

Plot- an area of defined size and shape that is intended for characterizing a homogenous occurrence of vegetation.

Phenology- the study of the timing of life cycle events in living organisms. In plant ecology, the term is used more generally to indicate the time frame for any seasonal biological phenomena, including flowering, fruiting, etc.

Physiognomy- vegetation structure determined by an interacting combination of environmental and historical factors, and species composition. It is characterized primarily by the horizontal and vertical distributions of plant biomass, particularly foliage biomass

Potential Vegetation- used to describe the vegetation of a given site that if left undisturbed, will eventually occur on that site with time. For example, the climax community or potential vegetation and the dominant species of a particular forest will be different from the existing forest and its dominant species.

Semi-Natural Vegetation- vegetation that has been shaped by both anthropogenic disturbances and ecological processes such as abandoned cultivated fields.

Shrub- 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.

Shrub 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.

Species- A group of individuals that usually breed only with one another and exhibit certain characteristics. Compare genus.

Stand- a spatially continuous unit of vegetation with uniform composition, structure, and environmental conditions. The term is often used to indicate a particular example of a plant community.

Stratum- a structural component of a community consisting of plants of approximately the same height (tree, shrub, or herb strata).

Structure- the spatial pattern of growth froms in a plant community, especially in regard to height, abundance and coverage with individual layers; whether vertical or horizontal spacing of the plants.

Submerged aquatic stratum- vegetation consisting of rooted or drifting plants that by-and-large remained submerged in the water column or on the aquatic bottom.

Subspecies- a category in taxonomic hierarchy that is below the species level; a taxonomic subdivision of the species; usually defined as a geographical race. Compare species and variety. Example: *Alnus incana* subspecies (ssp.) *tenuifolia* which is found from Alaska, the Yukon and Northwest Territories south throughout the western United States to California, Arizona, and New Mexico **vs.** *Alnus incana* subspecies (ssp.) *rugosa* which is found from central Canada the east coast and south through the upper Midwestern of Northeastern U.S.

Succession- the series of changes in an ecological community that occur over time after a disturbance.

Taxon (plural taxa)- A). a taxonomic unit in which living organisms (ie. plants) are classified (genera, species, subspecies and varieties). B). when used with respect to taxonomic nomenclature, the combination of the taxon along with a reference.

Tree- 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.

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.

Variety- a category in taxonomic hierarchy that is below the species level; a subdivision of the species which differs in some minor definable characteristic(s) from the rest of the species. Compare species and subspecies. Example: Ponderosa pine: *Pinus ponderosa* variety (var.) *scopulorum* **vs.** *Pinus ponderosa* variety (var.) *ponderosa*

Vascular Plant- (also known as *tracheophytes* or *higher plants*) are those plants that have lignified tissues for conducting water, minerals, and photosynthetic products through the plant. Vascular plants include the ferns, clubmosses, flowering plants, conifers and other gymnosperms.

Vegetation Type- a named category of plant community or vegetation defined on the basis shared floristic and/or physionomic characteristics that distinguish it from other kinds of plant communities or vegetation. This term can refer to units in any level of the NVC hierarchy.