Commentary

Contours of the Revised U.S. National Vegetation Classification Standard

The U.S. National Vegetation Classification (USNVC) has recently been completely revised. The USNVC is based on a partnership between nongovernmental organizations, the Ecological Society of America's Vegetation Panel and NatureServe, and federal partners, through the auspices of the Federal Geographic Data Committee Vegetation Subcommittee. Peet (2008) summarized two of the critical changes; the revised standard (1) provides new standards for the lower levels of the classification, the alliance and association, (2) implements a dynamic approach to maintaining the classification, such that it can be continually updated through an agreed-upon set of peer review procedures and data management tools. A third change is equally sweeping: a restructuring of the overall hierarchy. The revised hierarchy provides a more compelling and ecologically based structure for the entire classification, and is more likely to engage the majority of ecologists who describe patterns of vegetation at broader scales than the association or alliance. The association and alliance remain as critical foundations for detailed vegetation description.

The structure of the revised USNVC hierarchy is a substantial revision of the 1997 hierarchy, which relied heavily on the UNESCO (1973) physiognomic hierarchy for all levels above the alliance. The newly adopted national vegetation hierarchy consists of eight levels, organized into three upper levels, three middle levels, and two lower levels (Table 1).

Table 1. Comparison of original 1997 USNVC vegetation hierarchy and the 2008 revisions to that hierarchy.

1997 FGDC Hierarchy	2007 Revised Hierarchy (for Natural Vegetation)	
Division–Vegetation vs. Non-vegetation	Upper Level	
Order–Tree, Shrub, Herb, Nonvascular		
Level 1–Formation Class		Level 1–Formation Class
Level 2 - Formation Subclass		
Level 3–Formation Group		Level 2–Formation Subclass
Level 4–Formation Subgroup–Natural/ Cultural		
Level 5–Formation		Level 3–Formation
	Middle Level	Level 4–Division
		Level 5–Macrogroup
		Level 6–Group
Level 6–Alliance	Lower Level	Level 7–Alliance
Level 7–Association		Level 8–Association

The revised hierarchy addresses the following issues, among others (from FGDC 2008): (a) uses vegetation criteria to define all types (de-emphasizing explicit abiotic criteria, such as hydrologic regimes in wetland types), (b) provides a clear distinction between natural and cultural vegetation wherever these can be observed from broad growth form patterns (rather than combining natural and cultural vegetation initially and separating them at lower levels), (c) for natural vegetation, defines the upper levels based on broad growth form patterns that reflect ecological relationships (rather than detailed structural criteria, which are more appropriate lower down in the hierarchy), (d) provides a new set of middle-level natural units that bridge the large conceptual gap between alliance and formation, (e) integrates the physiognomic and floristic hierarchy levels based on ecologic vegetation patterns, rather than developing the physiognomic and floristic levels independently and then forcing them into a hierarchy, (f) provides detailed standards for plot data collection, type description and classification, data management and peer review of natural vegetation, and (g) for cultural vegetation provides an independent set of levels that addresses the particular needs of cultural vegetation. See Jennings et al. (2009) and Faber-Langendoen et al. (2008) for further details on the rationale behind these changes.

These revisions treat natural vegetation as distinct from cultural vegetation, and each has similar, but differently defined hierarchical levels. Thus the USNVC provides a dynamic portrait of existing vegetation, with the canvas containing not just natural and semi-natural vegetation, but all vegetation, in a way that reflects ongoing changes driven by land use, climate change, invasives, and natural processes. A comprehensive set of cultural vegetation units are available in pilot form for most levels of the revised USNVC, based on the Natural Resources Conservation Service's National Resources Inventory (NRI) (FGDC 2008:Appendix I). Natural vegetation units—being much more extensive in number—are still under development, but comprehensive pilots will be available within the next two years.

Criteria for natural vegetation

The standard breaks new ground on how to approach vegetation classification of existing vegetation. Floristic and physiognomic criteria are the primary properties of natural vegetation used to define all units of the classification. The choice of how these criteria are used is integrated with ecological and biogeographic considerations. The revised USNVC Standard includes criteria for all of the new and revised levels, as shown in Table 2.

The variety of vegetation criteria can be summarized as follows (FGDC 2008, see also Mueller-Dombois and Ellenberg 1974:154-155). *Physiognomic and structural criteria* include (1) Diagnostic combinations of growth forms; (2) Ecological patterns of either dominant growth forms or combinations of growth forms (growth forms of similar ecological (habitat) and dynamic significance, or growth forms of similar geographical distribution), and (3) Vertical stratification (layering) of growth forms (complexity in structure as produced by arrangement of growth forms). *Floristic criteria* include (1) Diagnostic combinations of species (differential and character species, constant species, dominant species), (2) Ecological combinations of species (indicator species of similar ecological (habitat) and/or dynamic significance, species of similar geographical distribution), (3) Vertical stratification (layering) of species (species patterns found in the dominant growth forms or strata, species patterns found between strata (overstory/understory), and (4) Numerical relation criteria (community coefficients, such as indices of similarity among plots within a type).

Too often vegetation classifiers rely solely on physiognomic or floristic criteria. The revised USNVC focuses on being a scientific natural vegetation classification, using multiple vegetation criteria to achieve the most natural groupings of vegetation types possible. The revised USNVC is more likely to be compatible with other multi-factor ecosystem classifications. Still, habitat factors (e.g., climate, soil type) or management activities are not an explicit part of the hierarchy; rather, they are used to help interpret the patterns expressed through the vegetation (Fig. 1).

Table 2. Summary of USNVC revised hierarchy levels and criteria for natural vegetation.

Hierarchy level	Criteria
Upper	Physiognomy plays a predominant role.
L1–Formation Class	Broad combinations of general dominant growth forms that are adapted to basic temperature (energy budget), moisture, and substrate/aquatic conditions.
L2–Formation Subclass	Combinations of general dominant and diagnostic growth forms that reflect global macroclimatic factors driven primarily by latitude and continental position, or that reflect overriding substrate/aquatic conditions.
L3–Formation	Combinations of dominant and diagnostic growth forms that reflect global macroclimatic factors as modified by altitude, seasonality of precipitation, substrates, and hydrologic conditions.
Middle	Floristics and physiognomy play predominant roles
L4–Division	Combinations of dominant and diagnostic growth forms and a broad set of diagnostic plant species that reflect biogeographic differences in composition and continental differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes.
L5–Macrogroup	Combinations of moderate sets of diagnostic plant species and diagnostic growth forms, that reflect biogeographic differences in composition and subcontinental to regional differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes.
L6–Group	Combinations of relatively narrow sets of diagnostic plant species (including dominants and co-dominants), broadly similar composition, and diagnostic growth forms that reflect regional mesoclimate, geology, substrates, hydrology, and disturbance regimes.
Lower	Floristics plays a predominant role
L7–Alliance	Diagnostic species, including some from the dominant growth form or layer, and moderately similar composition that reflect regional to subregional climate, substrates, hydrology, moisture/nutrient factors, and disturbance regimes.
L8–Association	Diagnostic species, usually from multiple growth forms or layers, and more narrowly similar composition that reflect topo-edaphic climate, substrates, hydrology, and disturbance regimes.

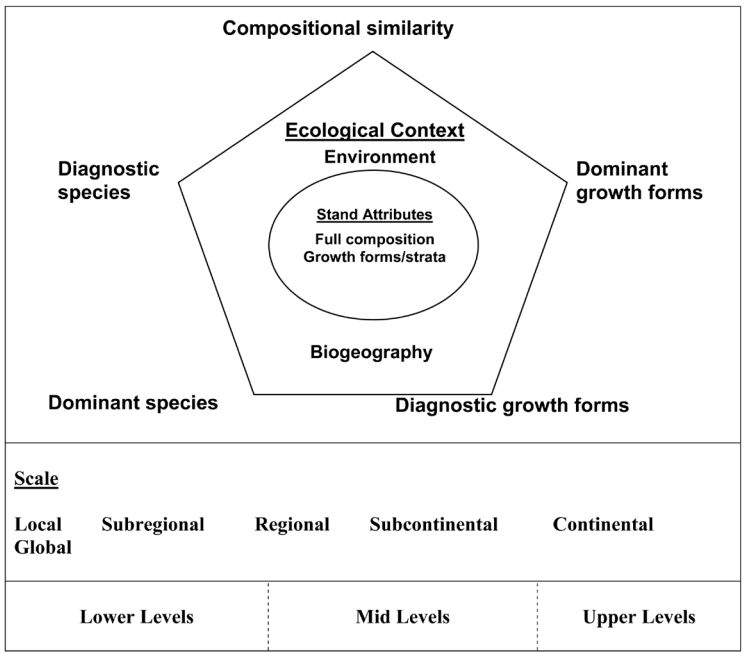

Fig. 1. Vegetation classification criteria for the USNVC (from FGDC 2008). The diagram portrays the five vegetation criteria used to classify vegetation at all levels of the USNVC hierarchy. These criteria are arranged from the most fine-scaled on the left to the most broad-scaled on the right. The five criteria are derived from stand attributes or plot data (inside oval) and reflect the ecological context (outside the oval) of the stand or plot. The ecological context includes environmental factors and biogeography considered at multiple scales, as well as natural and human disturbance regimes.

The question is how to structure these criteria across the different levels of the hierarchy. Here too the standard provides much guidance, suggesting how these different criteria can be weighted more toward physiognomy-ecologic at higher levels, combinations of physiognomy and floristics at mid levels, (guided by biogeographic, climatic, and other ecological factors), and more strongly floristic–ecologic criteria for the lowest levels (see Table 2). The intent is to provide as "natural" a classification of vegetation as possible.

From criteria to USNVC pilot development

Upper levels

The upper levels of the USNVC hierarchy are based on dominant and diagnostic growth forms that reflect environment at global to continental scales. A comprehensive set of formation types, for all three levels (L1–L3), are provided in pilot form by FGDC (2008). The formation concept has a long tradition in vegetation classification. In the revised USNVC, it is treated primarily as a physiognomic unit guided by ecological considerations, but importantly, it is open to some floristic input from lower levels.

Mid-levels

The mid-levels are based on dominant and diagnostic growth forms and compositional similarity reflecting biogeography and continental to regional environmental factors. Given the newness of these levels (L4–L6), these are in most active development. One need only review Barbour and Billings (2000) to realize that many descriptions of types across the country have already been completed for these mid-levels, but we lacked a reasonable classification structure to bring this information together. NatureServe defined ecological systems (Comer et al. 2003) in an independent effort to fill the gap

between the old USNVC formation and alliance levels. Now, as the revised USNVC hierarchy takes shape, those units are helping inform the new mid-levels, as are many other studies of North and South American vegetation.

A number of federal agency projects are supporting work on these levels. NatureServe, with support from the U.S. EPA, has drafted new USNVC hierarchy concepts for wetlands of the coterminous United States. For eastern forests, the USFS FIA program supported development of Divisions, Macrogroups, and Groups. The NPS Vegetation Inventory Program mapping project has been exploring the utility of the Group level to support the mapping process, though current funds are only available for individual park clusters. In California, the Fish and Game Program has developed Macrogroups and Groups for all Californian vegetation.

In the next two years a comprehensive first draft of all mid-level units are being developed and described through a variety of federal and nonfederal projects that will support teams of ecologists, including NatureServe staff, academic, agency and applied ecologists. The ESA Vegetation Panel will play a key role in assisting in the peer review process for of these projects.

Lower levels

The lower levels (L7 and L8) are based on diagnostic and/or dominant species and compositional similarity reflecting local to regional environmental factors. On behalf of the USNVC partnership, NatureServe has been maintaining and making available a set of provisional types for alliances and associations since 1997 ‹www.natureserve/explorer.org› Development of these types is summarized in Grossman et al. (1998) and Jennings et al. (2009). Alliances are anticipated to see substantial changes as a result of implementing new mid-levels of the USNVC hierarchy.

An example of the revised USNVC is shown in Table 3.

Conclusion

The Ecological Society of America can play a key role in guiding the screening and peer review that is needed to maintain the USNVC across all levels. The ESA Panel is now in the early stages of establishing the peer review teams.

Development of the revised USNVC reflects international input; indeed, NatureServe has worked with partners to promote an International Vegetation Classification (IVC) in conjunction with the USNVC. Ecologists in other countries, including Bolivia, Canada (where a Canadian National Vegetation Classification is well under way), Mexico, and Venezuela, have been testing similar models of vegetation classification in their countries (Faber-Langendoen et al. 2008). As U.S. ecologists test and peer review the USNVC, the ESA Panel hopes that, though coordination with partners of the IVC, we will also contribute to a comprehensive global classification of vegetation.

Table 3. Pilot example of the revised 2008 USNVC hierarchy set of types.

Revised hierarchy for natural vegetation	Example
Upper Levels	
1–Formation Class	Scientific Name: Mesomorphic Tree Vegetation Colloquial Name: Forest and Woodland
2–Formation Subclass	Scientific Name: Temperate Forest Vegetation Colloquial Name: Temperate Forest
3–Formation	Scientific Name: Cool Temperate Tree Vegetation Colloquial Name: Cool Temperate Forest
Mid-Levels	
4–Division	Scientific Name: *Pseudotsuga–Tsuga–Picea–Pinus* Forest Division Colloquial Name: Western North America Cool Temperate Forest
5–Macrogroup	Scientific Name: *Pseudotsuga menziesii–Quercus garryana–Pinus ponderosa–Arbutus menziesii* Macrogroup Colloquial Name: Northern Vancouverian Montane and Foothill Forest
6 - Group	*Pinus ponderosa–Quercus garryana–Pseudotsuga menziesii* Group Colloquial Name: East Cascades Oak–Ponderosa Pine Forest and Woodland
Lower Levels	
7–Alliance	Scientific Name: *Pinus ponderosa–Quercus garryana* Woodland Alliance Colloquial Name: Ponderosa Pine–Oregon White Oak Woodland Alliance
8–Association	Scientific Name: *Pinus ponderosa–Quercus garryana/Balsamorhiza sagittata* Woodland Colloquial Name: Ponderosa Pine–Oregon White Oak/Arrowleaf Balsamroot Woodland

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