ANNALI DI BOTANICA
Ann. Bot. (Roma), 2012, 2: 1–9
Journal homepage: http://annalidibotanica.uniroma1.it

BUILDING THE UNITED STATES NATIONAL VEGETATION CLASSIFICATION

Franklin S.[1*], Faber-Langendoen D.[2], Jennings M.[3], Keeler-Wolf T.[4], Loucks O.[5], Peet R.[6], Roberts D.[7], McKerrow A.[8]

[1] *School of Biological Sciences, University of Northern Colorado, Greeley, CO 80639; Ph 001-970-351-2650, USA*

[2] *NatureServe, 3467 Amber Road, Syracuse, NY 13215, USA*

[3] *Department of Geography, Moscow, ID 83843, USA*

[4] *California Department of Fish and Game, 1807 13th St., Sacramento, CA 95811, USA*

[5] *Department of Zoology, Miami University, Oxford, OH 45056, USA*

[6] *Department of Biology, University of North Carolina, Chapel Hill, NC 27599-3280, USA*

[7] *Department of Ecology, Montana State University, Bozeman, MT 59717-3460, USA*

[8] *USGS Core Science Analytics and Synthesis, Raleigh, NC 27695-7617, USA*

[*] *Correspondig author: Telephone: +001-970-351-2650; e-mail Scott.Franklin@unco.edu*

(Received 01 November 2011; received in revised form 18 January 2012; Accepted 19 January 2012)

Abstract - The Federal Geographic Data Committee (FGDC) Vegetation Subcommittee, the Ecological Society of America Panel on Vegetation Classification, and NatureServe have worked together to develop the United States National Vegetation Classification (USNVC). The current standard was accepted in 2008 and fosters consistency across Federal agencies and non-federal partners for the description of each vegetation concept and its hierarchical classification. The USNVC is structured as a dynamic standard, where changes to types at any level may be proposed at any time with new information. But, because much information already exists from previous work, the NVC partners first established methods for screening existing types to determine their acceptability with respect to the 2008 standard. Current efforts include a screening process to assign confidence to Association and Group level descriptions, and a review of the upper three levels of the classification. For the upper levels especially, the expectation is that the review process includes international scientists. Immediate future efforts include the review of remaining levels and the development of a proposal review process.

Keywords: classification, United States, hierarchical, national, NVC, standard

Introduction

The U.S. National Vegetation Classification (USNVC) emerged from a partnership between nongovernmental organizations – NatureServe and the Ecological Society of America's Vegetation Classification Panel (ESA Panel) – and federal partners, through the auspices of the Federal Geographic Data Committee Vegetation Subcommittee (FGDC, 1997). In its original form, the USNVC adopted the international structure of UNESCO (1973) for its classification, which also provided the basis for the parallel International Vegetation Classification (IVC) (Grossman et al., 1998). Recently, a revised standard for the USNVC has been adopted by the federal agencies (FGDC, 2008) through

doi: 10.4462/annbotrm-9261

input from federal scientists, members of the ESA Panel, and a Hierarchy Revisions Working Group (HRWG; a task force established by the FGDC Vegetation Subcommittee). The revisions were the result of over a decade of collaboration (Peet, 2008), and the standard has now been approved for use by all federal agencies (FGDC, 2008) and described for the scientific community (Jennings et al., 2009). The objectives of this synthesis are to give a brief introduction to the USNVC, describe the initial screening processes being used to populate the USNVC, and explain the dynamic content of the USNVC. Detailed explanation of the USNVC can be found elsewhere (Jennings et al., 2009). We relate the USNVC to other European efforts of classification and suggest that, through an internationally agreed upon process relying on the physiognomic-floristic-ecological approach, these efforts could be coordinated or cross-linked at upper and mid levels of the hierarchy (see Peet & Roberts, 2012).

Why a National Classification?

While nearly all public lands in the United States have some form of vegetation classification system and mapping for management purposes, prior to the USNVC there had been no coordinated effort to integrate the multitude of classifications. Without such integration, the United States lacked the ability to inventory community types, determine their rarity and biodiversity, and coordinate national land stewardship (e.g., management of invasive species) (Maybury, 1999). Analogous classification efforts for conservation and land management in Europe include the EUNIS Habitat Classification and Natura 2000 (Davies & Moss, 2002; Habitats Committee, 2007), the European Vegetation Survey (Rodwell et al., 2002), and the Map of the Natural Vegetation of Europe (Bohn et al., 2000).

Confronted with disparate classification systems for many natural resources, the United States created the Federal Geographic Data Committee (FGDC) with various subcommittees to formulate national standards. The charges to the FGDC Vegetation Subcommittee were to: 1) define and adopt standards for vegetation data collection and analysis, 2) facilitate inter-agency collaboration and inter-agency product consistency, 3) foster accuracy, consistency, and clarity in the structure, labelling, definition and application of a systematic vegetation classification for the U.S., 4) establish a national set of standards for classifying existing vegetation, 5) develop minimum metadata requirements, and 6) collaborate between state, federal and international efforts (FGDC, 2008). The FGDC Vegetation Subcommittee was composed of agency personnel (US Forest Service, US Geological Survey, Bureau of Land Management, Natural Resources Conservation Service, National Park Service, among others), academics associated with the Ecological Society of America Panel on Vegetation Classification (established in 1994 specifically to foster integration and unification of vegetation classifications within the country), and scientists from NatureServe (whose staff and Network of Natural Heritage Program ecologists provide expertise in vegetation classification and data management). Such a coordinated effort has allowed for the development of an ecologically sound classification that is useable for land stewardship and readily available over the web.

What is the USNVC?

The FGDC (2008) standard summarized the role of the USNVC as follows:

- This national standard requires all federal vegetation classification efforts to meet core data requirements that are the same across all federal agencies to permit aggregation of data from all federal agencies. This will facilitate the ongoing, dynamic development of a vegetation classification content standard (i.e., the NVC). The Standard also requires that vegetation mapping and inventory units crosswalk to the NVC. This means that the composition of any map unit or inventory unit can be described in terms of one or more vegetation types at an appropriate level of the NVC hierarchy.

- This Standard shall not preclude alternative classification approaches and systems that address particular needs of Federal agencies. It is intended to facilitate an orderly development of a national vegetation classification as well as collaboration with international vegetation classification activities. The standard should not hamper local Federal efforts from doing whatever they need to meet their specific purposes, such as inventory, monitoring, and mapping.

Thus, the USNVC is a reporting standard for federal agencies, but each Federal agency is free to develop additional vegetation classification systems that meet their own information and business needs (FGDC, 2008).

THE USNVC HIERARCHY –NATURAL VEGETATION

The hierarchy of the USNVC was originally developed from the physiognomically-based UNESCO hierarchy (UNESCO, 1973; FGDC, 1997). Shortcomings of this system were identified over the next decade (Table 1) and included the substantial conceptual jump from the formation level, based on physiognomic criteria, to the Alliance level, based on dominant and diagnostic taxa, and mixing of cultural and natural vegetation within the hierarchy. NatureServe ecologists developed the ecological systems classification (Comer et al., 2003; Josse et al., 2003) in part to overcome some of these shortcomings, but a more formal revision was needed. The HRWG developed a revision of the hierarchy by formally describing the scientific basis for a revised hierarchy using a vegetation-ecologic approach (Faber-Langendoen et al., 2008). The ESA Panel provided detailed standards for the alliance and association (Jennings et al., 2009) with methods of vegetation field plot sampling, data management, and type descriptions relevant to all levels of the hierarchy.

Table 1. Comparison of original 1997 USNVC vegetation hierarchy and the 2008 revisions to that hierarchy. See also Table 2, which provides the details on the natural vegetation hierarchy.

1997 FGDC Hierarchy	2007 Revised Hierarchy (for Natural Vegetation)
	"Upper Level"
Division — Vegetation vs. Non - vegetation	
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
	"Lower Level"
Level 6 — Alliance	Level 7 — Alliance
Level 7 — Association	Level 8 — Association

The revised USNVC is hierarchical and incorporates physiognomic (upper 3 levels), general floristic-physiognomic-biogeographic (mid 3 levels), and detailed floristic (lower 2 levels) criteria (Table 2). The hierarchy is based on a formal structure in which types are arranged according to natural, scientific relationships. That is, a type can be recognized if certain growth forms are dominant, certain diagnostic species are present, the composition is typified by constant and dominant species, and together these reflect a specified ecology and biogeography of the type. While the classification is based on vegetation data, significant anthropogenic or biogeographic context has been incorporated into the classification. For example, the anthropogenically-based agricultural and developed vegetation are separated from natural vegetation at the highest level (Formation Class), and separate hierarchical levels are provided for cultural vegetation (see FGDC, 2008). Some of the key characteristics of the approach are that it classifies all areas with > 1% vegetation cover (natural or cultural), classifies existing vegetation regardless of site potential or land use, and typically defines upper level types using a "combination of growth-forms."

Table 2. Summary of natural USNVC hierarchy levels, concept of each level, and example classification (FGDC 2008).

LEVEL	CONCEPT	EXAMPLE
	Upper - Physiognomic	
L1 – Formation Class	Broad combinations of general dominant growth forms that are adapted to basic temperature (energy budget), moisture, and substrate/aquatic conditions.	Shrubland & Grassland *[mesomorphic]*
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.	Temperate & Boreal Shrubland & Grassland
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.	Temperate Grassland & Shrubland
	Middle – Physiognomic, Biogeographic and Floristic	
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.	Great Plains Grassland & Shrubland
L5 – Macrogroup	Combinations of moderate sets of diagnostic plant species and diagnostic growth forms, that	Tallgrass Prairie Grassland & Shrubland

→ next

LEVEL	CONCEPT	EXAMPLE
	Middle – Physiognomic, Biogeographic and Floristic	
	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.	Tallgrass Mesic Prairie Grassland
	Lower – Floristic	
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.	Big Bluestem – Indian grass Grassland
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.	Big Bluestem – Indian grass / Gayfeather Grassland

A critical addition to the revised USNVC was the development of three new middle levels (Division, Macrogroup and Group) for natural vegetation based on combinations of dominant and diagnostic growth forms, compositional similarity, and dominant and diagnostic species that reflect continental and regional biogeographic factors. These new mid-levels provide the bridge between the old USNVC's alliance and formation concepts (FGDC, 2008; Faber-Langendoen et al., 2009). Middle levels are based on commonly recognized classification types and provide a more suitable basis for mapping regional and national vegetation patterns and addressing regional land stewardship issues. For example, Society of American Forester Cover Types (Eyre, 1980) and Society for Range Management Cover Types (Shiflet, 1994) are somewhat comparable to USNVC Alliances and Groups.

USNVC AND INTERNATIONAL PARTNERSHIP

The USNVC is not unlike other hierarchical vegetation classifications (Table 3) and was developed with such international conventions in mind. However, the USNVC is different from those in Europe in its peer review process methods and using a team-based synthetic approach to build a comprehensive classification that is perfectly tiled from the lowest level (Association) to the highest level (Formation Class). The hierarchical approach is meant to accommodate all types of vegetation concepts. By building on international conventions, such as the Formation and Division, this approach can find much compatibility with that of the Braun-Blanquet hierarchy (e.g., Westhoff & van der Maarel, 1973; Rodwell et al., 2002; and see Peet & Roberts 2012).

Table 3. Comparison of USNVC hierarchy levels with other vegetation classification hierarchies. Classifications are arranged in order of most similarity to the NVC approach. A number of other classification approaches not shown here have strong similarity to the NVC for a specific level or two. For example, the World Wildlife Fund Major Habitat Types (Olson et al., 2001) are very similar to USNVC Formations; NatureServe Ecological Systems (Comer et al., 2003) are similar to USNVC Groups and Alliances; SAF Cover Types (Eyre, 1980) and Rangeland Cover Types (Shiflet, 1994) are somewhat comparable to USNVC Alliances and Groups; and SAF Major Forest Cover Types to USNVC Groups and Macrogroups.

USNVC and IVC	Braun-Blanquet[1]	Brown et al. 1998[2]	Rübel[3]
Upper			
L1 – Formation Class			
L2 – Formation Subclass			
L3 – Formation	*Formation*[4]	*Formation-type*	Formation
Middle			
L4 – Division	*Division*[4]		
L5 – Macrogroup	Class	Biotic Community	
L6 – Group	Order		
Lower			
L7 – Alliance	Alliance	Series/Alliance	Alliance
L8 – Association	Association	Association	Association

[1] Westhoff and vanderMaarel, 1973, Pignatti et al., 1994.
[2] Brown et al.,1998. The relationships of the NVC levels with the Brown et al., levels are not entirely straightforward, because in the upper levels they use a strict regionalization by biogeographic region and climatic zone, coupled with hydrologic regime. Thus we do not show all of their levels. But the net result is that the formation-type has comparable units to the NVC formation and division levels.
[3] Rübel, 1930 in Shimwell, 1971.
[4] The Formation and Division are not a formal part of the Braun-Blanquet hierarchy, but they are often used to organize the Class level.

The Alliance and Association level concepts also encompass all known US plant associations (>6000), whether or not

supported through formally compiled vegetation plot data, that are distinctive from one another. This is in contrast to the Braun-Blanquet approach, where classification is based on formal type descriptions of plot data, and associations are published like species independent of other, pre-existing types. Further, the bottom-up Braun-Blanquet approach requires that the lowest based unit – the association – be defined before upper level units can be described. In practice, however, there is some fluidity, as evidenced by the methods used for the Natural Vegetation Map of Europe and other plot-based classification systems (Bohn et al., 2003; Chytrý et al., 2011). In the U.S., the simple fact is that the vegetation plot data that exist in standard databases are limited and likely to remain so in the near future. But the key innovation of the USNVC method is a framework that builds on the hundred or more years of vegetation classification and description; a framework that includes all known possible community concepts and which can be altered as needed (Grossman et al., 1998). Thus, the USNVC can be considered a working hypothesis or model. Moving forward, there is a strong need to encourage systematic plot work and literature review — for those types with less background data — to improve the overall quality of the USNVC.

The Canadian National Vegetation Classification (CNVC, Meidinger et al., 2001), the International Vegetation Classification (IVC, Grossman et al., 1998; Faber-Langendoen et al., 2012) and the USNVC have the same hierarchical structure because they were essentially developed together with overlapping personnel. A coordinated effort is in place to match descriptions of vegetation types from all levels that span political boundaries using the International Vegetation Classification, which spans North America as well as South America and much of Africa (Faber-Langendoen et al., 2012). To that end, Central and South American colleagues are involved in the building and reviewing of the USNVC. While it is clear that the European and North American classification approaches are different, it is also clear that linking these and other global classification efforts will lead to greater knowledge of biotic resources (Maybury, 1999; Olson et al., 2001; Chytrý et al., 2011).

Building the USNVC - The Initial Review Process

The revised 2008 FGDC standard retained the alliance and association level, but completely revised the upper levels of the hierarchy (see Table 1). Content for the upper levels has subsequently been developed but has not yet been finalized. We describe here the three separate screening processes (Association and Alliance, Group and Macrogroup, upper Formation levels) currently underway, their status, and future work. No process has yet been developed for the Division level.

Screening Associations and Alliances

In 1998, The Nature Conservancy ecology staff (subsequently transferred to NatureServe) completed a synthesis underway for several decades, working state-by-state to develop descriptions of all vegetation found in the United States (Grossman et al., 1998). These descriptions were sometimes based on plot data and published works but also sometimes based on field observations by regional experts. While not perfect, the descriptions provided an initial attempt to classify all known vegetation units in the United States. A logical next step to building this level of the USNVC, mandated by the 2008 revised FGDC stgandards, was to peer-review these descriptions (legacy classification, Fig. 1). The goal was to create a starting point (initial classification) that could then be changed based on additional studies, plot data, and more rigorous analyses.

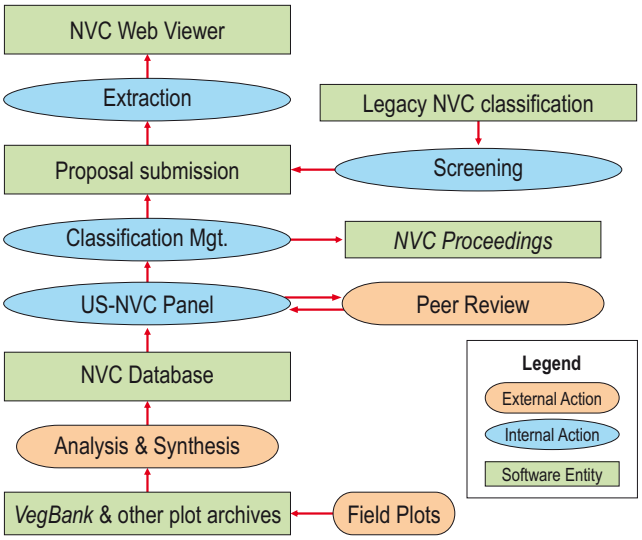

Figure 1. Proposed data flow for the USNVC. The initial screening process built the USNVC from new descriptions written at the middle and upper levels (mostly by the Hierarchical Divisions Working Group, a component of the FGDC Vegetation Subcommittee) and description previously written (legacy) by NatureServe ecologists at the lower levels. Subsequent to building the initial USNVC, plot data may be collected and analyzed to develop proposals for revision of the classification. Such changes will be reviewed by an internal panel of vegetation ecologists and, upon acceptance, included in the USNVC (thus making the classification dynamic). A record of the change will be housed in an on-line Proceedings.

The Association review process was developed by the ESA Vegetation Panel and applied by NatureServe. For each of the > 6000 established associations, reviewers applied

criteria that served as a confidence-level screening tool. Criteria included number of plots supporting the description, published type description of equivalent concepts in the literature, level of rigor of the documentation supporting the type description, and completeness of the description in the NatureServe vegetation classification database (proper naming, type concept summary, vegetation description with diagnostic species, environment, dynamics, range, etc.). The result of the screening was assignment of a level of confidence (provisional, low, medium, and high) to each association description: provisional associations were insufficiently described; low confidence associations had insufficient plot data, had minimal literature support and incomplete database descriptions; medium confidence associations either had good plot data and publications but of varying or limited quality, or no plot data but excellent publications and database documentation; and high quality associations had high quality plot data, clear diagnostic species, were described throughout their range, and had supporting publications and database documentation. The screening process (Faber-Langendoen et al., 2011), now completed, provides a systematic evaluation of our level of knowledge of associations across the U.S. and a basis for future classification research and improvement. The descriptions are currently being housed in NatureServe's Biotics database and on the NatureServe Explorer website *(www.natureserve.org/explorer)* until the USNVC database system and webserver are ready. Alliances, developed in a similar manner to the associations, will be screened using the same criteria, after alliance concepts are adjusted to fit the revised hierarchy and funds become available for screening.

Screening Groups and Macrogroups

The second project for building the USNVC was writing descriptions for the Group level. This level was chosen based on its practical value for vegetation mapping and land stewardship. Funding to NatureServe staff has allowed for the full development of written descriptions at the Group level and brief descriptions at the Macrogroup level. The ESA Vegetation Panel developed a review process similar to that employed by scientific journals (Fig. 2). An Editor-In-Chief (EIC) oversees regional Associate Editors (AE) who recruit reviewers with expertise in specific vegetation types. Descriptions written by NatureServe staff were sent to AEs and subsequently placed on a Sharepoint site (a web application platform for document managing) for both AEs and reviewers to access. AEs (21 experts of regional vegetation types) were responsible for finding qualified scientists to review group descriptions. The reviewers returned their comments to the AEs who added their input and sent all comments back to the original authors of the description for modification. Authors resubmitted their modified descriptions back to the AE who then made a recommendation to the EIC for acceptance at some confidence level (the same confidence levels as used for the association screening).

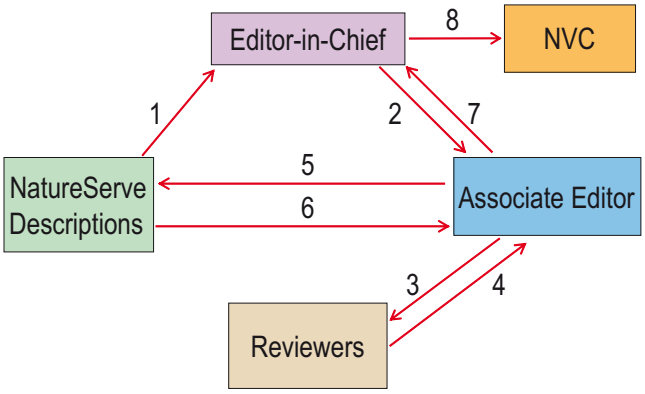

Figure 2. Initial screening of the Group level of the USNVC started with the descriptions written by NatureServe staff and submitted for review by the Editor-In-Chief (EIC). Associate Editors (AE) were chosen based on their knowledge of specific vegetation and oversee the review process by choosing experts of certain vegetation types to review descriptions for content quality (see text for details). AEs themselves reviewed each description for matching format and, upon receiving reviewer comments, content quality. AEs incorporated reviewer comments and submitted their recommendations to the EIC. The EIC submitted the review and quality-labelled description to the USNVC.

Steps:

1. Submission of the NatureServe Group descriptions to the Editor-in-Chief (EIC).
2. The EIC will assign Group descriptions to Associate Editors (AEs), who will screen them based on the proposed screening process. Each unit will be reviewed with similar units to make sure the units are both distinct and real.
3. AEs will request at least two reviewers with expertise in vegetation classification and the specific vegetation of the Groups. Each reviewing member will be responsible for determining if units meet all middle level screening criteria and criteria necessary for acceptance, and for providing explicit reasons for the status decision they conclude from the screening process.
4. Reviewers submit screening documents and comments back to AEs.
5. AEs submit all changes they or the reviewers have suggested back to NatureServe staff to improve descriptions based on their knowledge and time.
6. Updated descriptions are then sent back to the AE.
7. A face-to-face Panel meeting will be used to bring all reviewers together and finalize the reviewing process, and the Panel will submit their recommendation to the EIC.
8. Upon acceptance, EIC will submit the necessary documentation to the USNVC.

The review process incorporates two forms of review. A 'general review' is the charge of the AE, who makes sure that all fields of the description are completed, that descriptions

of groups are truly individual (different from other related groups), and that groups fit into the Macrogroup concepts as briefly described. Individual Peer Reviewers are asked to do a more comprehensive 'concept review,' based on the descriptive information provided (comparable to that of association information, above) and to assign a confidence level to the type. Detailed Group and brief Macrogroup descriptions will be posted on the usnvc.org website and organized within the Formation and draft Division units in fall 2012.

Screening Formation Class, Formation Subclass, and Formations

The third task in building the revised USNVC involves evaluation of the highest levels of the classification, including review of the Formation Class, Formation Subclass, and Formation descriptions (Fig. 3). These descriptions had been drafted by NatureServe staff and the HRWG for the USNVC, and the types were based on a wide variety of national and international precedents (e.g., Ellenberg & Mueller-Dombois, 1967; Whittaker, 1975, Olson et al., 2001; Box & Fujiwara, 2012). Comprehensive description development involved the reestablishment of the HRWG. Their first task was to work through questions regarding the hierarchy that had emerged since its last revision. For example, resolving the level at which wetland types should be separated and what percent canopy cover separates grassland and shrubland from woodland and forest. The HRWG considered both US agency precedent and international precedent so as to maximize the likelihood that the USNVC would integrate well with other activities of US agencies and would transfer across political boundaries to crosswalk with other international classification efforts.

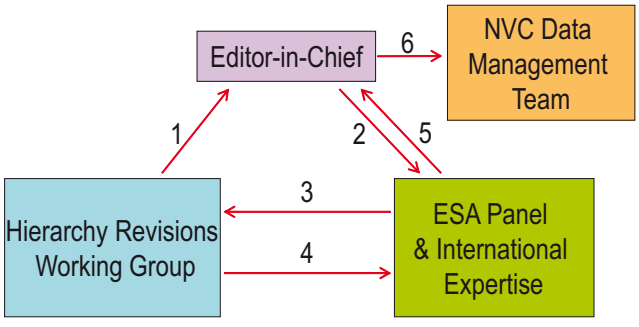

Figure 3. Initial screening review process for the upper level descriptions. The Hierarchical Divisions Working Group of the USNVC has written descriptions for all Formation Classes, Formation Subclasses, and Formations. Descriptions were then submitted for review by the Editor-In-Chief (EIC). Reviews were completed by ESA Panel members and colleagues both within and outside the US. The comments of these ecologists were incorporated into the descriptions by the EIC and subsequently placed into the USNVC.

Steps:
1. Submission of the HRWG descriptions to the Editor-in-Chief (EIC).
2. EIC splits up the upper level unit descriptions and assigns them to specific ESA Panel members. Each unit will be reviewed with similar units to make sure the units are both distinct and real, and that units fit hierarchically.
3. The Panel will then submit their comments back to the HRWG to improve descriptions based on their knowledge and time;
4. Updated descriptions will be sent back to the ESA Panel.
5. A fae-to-face Panel meeting will be used to bring all reviewers together and finalize the reviewing process, and the Panel will submit their recommendation to the Editor-in-Chief
6. Upon acceptance, the EIC will submit the necessary documentation to the USNVC.

All descriptions were completed by October 2011 (HRWG, 2011). ESA Panel members reviewed these descriptions based on their own expertise from a bottom-up approach: focus first on the Formation descriptions (are they distinct and clear), then on the fit of the formation descriptions into Formation Subclasses as well as the distinctness of descriptions among Formation Subclasses, and finally the fit of the Formation Subclass descriptions in the Formation Class description. Because many of these upper-level descriptions are pan geographic, ESA Panel members have reached out to international colleagues to solicit their reviews. Agreement on the merits of these units will provide a starting point for continental collaboration.

Future Planned Effort

Screening of the Alliances is a top priority, as is expanded description of the Macrogroup level and concept review of the Division levels. As these levels mature, they will be subject to further screening and review.

Plant communities are temporally and spatially dynamic; they change at all possible scales. Some of this change may happen within the bounds of current vegetation type concepts (based on our understanding of vegetation patterns over the last hundreds of years), but increasingly, new types may form because of land use, invasives, and climate change ("novel" ecosystems). For this reason, the added value of having a dynamic standard for the USNVC is that possible new types can be evaluated as they emerge.

The USNVC partners have been able to create a peer review structure to guide the initial population of types across all levels of the hierarchy. Now the challenge is to create a sustainable review process that can handle a more formal approach. It will be important that we allow alterations to the current classification as data and improved descriptions become available. The recent paper by Matthews et al. (2011) provides a model in that a new comprehensive plot

data base is provided for a subset of the USNVC, together with new type descriptions and a mapping between old and new type concepts. Under the auspices of the FGDC, the ESA Panel will be responsible for overseeing the review of such proposed changes, and all changes will be published in an on-line proceedings (Fig. 1). All descriptions will then have a record of changes over time analogous to species taxonomy authority.

Concluding Remarks

It is clear that standardized classifications are being requested throughout the world (Chytrý et al., 2011) and that any effort to develop global metrics of vegetation status and trends will require a collaborative effort and agreed upon understanding of how to define and describe vegetation types. This may become even more critical with the challenge of developing global ecosystem red lists (Rodriguez et al., 2011). At a minimum, we must aspire to classification systems that are internally consistent and comprehensive, yet which provide the ability to crosswalk internationally. To that end, the goal of developing the USNVC is to incorporate the expertise and input of international scholars; an invitation made at the 2011 European Vegetation Survey meeting. There are inherent values in the different approaches to building classifications, but linking such efforts is the only way to answer global questions.

Acknowledgements

The authors thank members of the Ecological Society of America Panel on Vegetation Classification, the Federal Geographic Data Committee Vegetation Subcommittee, and NatureServe staff, whose advice and expertise throughout the screening and building of the USNVC, were and remains invaluable. We thank Jen Costanza (USGS), and an unknown reviewer for helpful comments on an earlier version of the manuscript. USNVC development has been supported by the US Forest Service, the US Geological Survey and the US National Science Foundation.

References

Bohn U., Gollub G., Hettwer C., 2000. Map of the Natural Vegetation of Europe. Federal Agency for Nature Conservation, Bonn, Germany.

Box, E.O., Fujiwara K., 2012. Vegetation types and their broad-scale distribution. In: Franklin, J. & van der Maarel, E. (Eds.) Vegetation Ecology, Second edition. Oxford Univ. Press. New York, NY.

Brown D.E., Reichenbacher F., Franson S.F., 1998. A Classification of North American Biotic Communities. The University of Utah Press, Salt Lake City.

Chytrý M., Schaminée, J.H.J., Schwabe A., 2011. Vegetation survey: a new focus for Applied Vegetation Science. Applied Vegetation Science 14, 435-439.

Comer P., Faber-Langendoen D., Evans R., Gawler S., Josse C., Kittel G., Menard S., Pyne M., Reid M., Schulz K., Snow K., Teague J., 2003. Ecological systems of the United States: a working classification of U.S. terrestrial systems. NatureServe, Arlington, Virginia, USA.

Davies C.E., Moss D., 2002. EUNIS Habitat Classification. Final Report to the European Topic Centre on Nature Protection and Biodiversity, European Environment Agency. February 2002.

Ellenberg H., Mueller-Dombois D., 1967. Tentative physiognomic-ecological classification of plant formations of the Earth. Geobotanisches Institut Eldgenössische Technische Hochschule Stiftung Rübel, Zürich 37, 21-55.

Eyre F.H., 1980. Forest Cover Types of the United States and Canada. Society of American Foresters, 148 pages.

Faber-Langendoen D., Tart D., Gray A., Hoagland B., Huber O., Josse C., Karl S., Keeler-Wolf T., Meidinger D., Ponomarenko S., Saucier J.P., Velázquez-Montes A., Weakley A., 2008. Guidelines for an integrated physiognomic–floristic approach to vegetation classification. Hierarchy Revisions Working Group, Federal Geographic Data Committee, Vegetation Subcommittee, Washington, D.C., USA.

Faber-Langendoen D., Tart D.L., Crawford, R.H., 2009. Contours of the revised U.S. National Vegetation Classification standard. Bulletin of the Ecological Society of America 90,87–93.

Faber-Langendoen D., Snow K., Russo M., Hall M., Kittel G., Schulz K., Pyne M., Nordman C., Menard S., Drake J., Sneddon L., Gawler S., 2011. Screening Provisional Associations for Inclusion in the U.S. National Vegetation Classification Types. NatureServe, Arlington, VA.

Faber-Langendoen D., Comer P., Josse C., 2012. An introduction to the International Vegetation Classification. NatureServe, Arlington, VA.

FGDC (Federal Geographic Data Committee), 1997. Vegetation classification standard, FGDC-STD-005. Retrived from *http://www.fgdc.gov/Standards/Documents/*

Standards/Vegetation.

FGDC (Federal Geographic Data Committee), 2008. National Vegetation Classification Standard, Version 2 FGDC-STD-005-2008 (version 2). Vegetation Subcommittee, Federal Geographic Data Committee, FGDC Secretariat, U.S. Geological Survey, Reston, Virginia, USA.

Grossman D.H., Faber-Langendoen D., Weakley A.W., Anderson M., Bourgeron P.S., Crawford R., Goodin K., Landaal S., Metzler K., Patterson K., Pyne M., Reid M., Sneddon L., 1998. International classification of ecological communities: terrestrial vegetation of the United States. Volume I. The National Vegetation Classification System: development, status, and applications. The Nature Conservancy, Arlington, Virginia, USA.

Habitats Committee, 2007. Natura 2000 Interpretation Manual of European Union Habitats - EUR27. European Commission Directorate-General for the Environment, Nature and Biodiversity. Brussels, Belgium.

HRWG (Hierarchy Revisions Working Group), 2011. Descriptions of global formation types. Contributing authors: Faber-Langendoen D., Josse C., Hoagland B., Navarro G., Keeler-Wolf T., Meidinger D., Helmer E., Fults G., Huber O., Ponomarenko S., Saucier J-P., Tart D., Weakley A. Federal Geographic Data Committee, FGDC Secretariat, U.S. Geological Survey, Reston, VA, and NatureServe, Arlington, VA.

Jennings M.D., Faber-Langendoen D., Loucks O.L., Peet R.K., Roberts D., 2009. Characterizing Associations and Alliances of the U.S. National Vegetation Classification. Ecological Monographs 79, 173-199.

Josse C., Navarro G., Comer P., Evans R., Faber-Langendoen D., Fellows M., Kittel G., Menard S., Pyne M., Reid M., Schulz K., Snow K., Teague J., 2003. Ecological Systems of Latin America and the Caribbean: A Working Classification of Terrestrial Systems. NatureServe, Arlington, VA.

Matthews E.R., Peet R.K., Weakley A.S., 2011. Classification and description of alluvial plant communities of the Piedmont region, North Carolina, USA. Applied Vegetation Science 14, 485-505.

Maybury K.P. (ed.), 1999. Seeing the Forest and the Trees: Ecological Classification for Conservation.The Nature Conservancy, Arlington, VA.

Meidinger D., MacKenzie W., Klinka K., Pojar J., 2001. A Synopsis of Vegetation Classes, Orders and Suborders of British Columbia, 31 p. Web report:
http://www.for.gov.bc.ca/hre/becweb. B.C. Ministry of Forestry, Victoria, BC.

Olson D.M., Dinerstein E., Wikramanayake E.D., Burgess N.D., Powell G.V.N.,Underwood E.C., D'Amico J.A., Itoua I., Strand H.E., Morrison J.C., Loucks C.J., Allnutt T.F., Ricketts T.H., Kura Y., LaMoreux J.F., Wettengel W.W., Hedao P., Kassem K.R., 2001. Terrestrial Ecoregions of the World: A New Map of Life on Earth. BioScience 51, 933-938.

Peet R.K., 2008. A decade of effort by the ESA Vegetation Panel leads to a new federal standard. ESA Bulletin 89, 210-211.

Peet R.K., Roberts D.W., 2012. Classification of natural and semi-natural vegetation. Chapter 4 in J. Franklin and E. van der Maarel, eds. Vegetation Ecology. Second edition. Oxford University Press, New York, NY.

Pignatti S., Oberdorfer E., Schaminee J.H.J., Westhoff V., 1994. On the concept of vegetation class in phytosociology. Journal of Vegetation Science 6, 143-152.

Rodwell J.S., Schamineé J.H.J., Mucina L., Pignatti S., Dring J., Moss D., 2002. The diversity of European vegetation. An overview of phytosociological alliances and their relationships to EUNIS habitats. Wageningen, NL. EC-LNV Report EC-LNV nr.2002/054.

Rodríguez J. P., Rodríguez-Clark K.M., Baillie J.E.M., Ash N., Benson J., Boucher T., Brown C., Burgess N.D., Collen B., Jennings M., Keith D.A., Nicholson E., Revenga C., Reyers B., Rouget M., Smith T., Spalding M., Taber A., Walpole M., Zager I., Zamin T., 2011. Establishing IUCN Red List criteria for threatened ecosystems. Conservation Biology 25(1), 21-29.

Rübel E., 1930. Pflanzengesellschaften der Erde. Bern/ Berlin: Huber.

Shiflet T.N. (ed.), 1994. Rangeland Cover Types of the United States. Society for Range Management. Denver, CO.

Shimwell D.W., 1971. The Description and Classification of Vegetation. University of Washington Press, Seattle.

UNESCO (United Nations Educational, Scientific, and Cultural Organization), 1973. International classification and mapping of vegetation. Series 6. Ecology and Conservation. United Nations, Paris, France.

Westhoff V., van der Maarel E., 1973. The Braun-Blanquet approach. In: Whittaker R.H. (Ed.) Classification of Plant Communities, 617–726. Dr. W. Junk Publishers, The Hague, Netherlands.

Whittaker R.H., 1975. Communities and ecosystems. Second edition. MacMillan, New York.