

A Vision for Implementing a Vegetation Classification for the United States

Prepared for

The Ecological Society of America and its institutional partners

Prepared by

The Ecological Society of America's Panel on Vegetation Classification

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Overview

A unified national classification for the vegetation of the United States is critically important to basic scientific research as a tool for organizing, analyzing and synthesizing ecological information. It is vital to natural resources management and biological conservation for inventory, monitoring and planning.

This report articulates our vision for functions that need to be provided and roles that must be filled for successful implementation of a scientifically credible vegetation classification system for the United States. The functions identified are separated into the core components of the classification system for analysis. Ongoing activities for each of the functions are briefly described, including identification of who is currently taking responsibility and who in the future should take responsibility for the various cooperative activities that are necessary. From this we have developed a set of recommendations that spell out our vision for work by the Panel in the years ahead. We hope that this will result in discussion and consensus within ESA and among our partners, allowing us to focus clearly on what the Panel should do and exactly where collaboration might be productive and mutually beneficial.

Recent technological advances have made quantitative analyses of sample data, both field based and remotely sensed, possible at broad spatial scales. These advances can help address issues such as ecosystem management, conservation planning, and understanding global climate change. All of these activities require that ecological units based on vegetation be defined and that their distribution on the landscape be known. However, the effectiveness and potential synergy of such activities depends in large part on the availability of underlying standards and a common set of well-defined, broadly accepted units for classification. Before such a system can be operational and broadly accepted, an information infrastructure is needed to manage the very large number (10^7) of vegetation field plot records and large number (10^4) of plant association descriptions that are expected to form its basis. Equally important is a peer review system to evaluate proposals for changes in the recognized units of vegetation, as well as for changes in the classification itself. After several years of conceptual development, writing, and review, the ESA Vegetation Panel proposes to implement the requisite information infrastructure and peer review system in collaboration with its partner organizations.

The following are recommendations for the role of The Panel for implementing a U.S. Vegetation Classification. The first is broad, the rest more specific.

1. Develop detailed operational classification standards and guidelines for the U.S. Vegetation Classification (USVC). These standards and guidelines should address (a) definition and modification of floristic units; (b) the requirement that units be based on field plot data; (c) the need for an open, scientifically rigorous peer review process; (d) requirements and mechanisms for publication of floristic unit descriptions; and (f) mechanisms for assuring the availability and dissemination of supporting data.
2. Establish and publish standards for vegetation field plot data that would be required to develop new or revise existing floristic units of the USVC.

3. Establish and publish detailed standards for recognizing a floristic unit based on strict standards of definition, documentation, review, and access to the primary field plot data.
4. Collaborate with other institutions to encourage and facilitate development of biological nomenclature standards to meet the informatics needs of the USVC and for a database integration system of taxonomic authorities.
5. Review proposed changes to the physiognomic levels of the USVC.
6. Remain open to alternative hierarchical classifications for application above the level of the association.
7. Support the activities of the Federal Geographic Data Committee (FGDC) by providing independent review and advice in support of their promulgation of standards. Results of Panel deliberations should be presented in a fashion appropriate for FGDC review and possible adoption.
8. Work collaboratively to establish and maintain an efficient peer-review process for proposed additions and changes to an accepted list of community types.
9. Seek establishment of an electronic journal, "Annals" or "Proceedings," through which to publish monographic vegetation analyses as well as revisions to the list of associations and alliances in the USVC.
10. Develop and implement plans for launching, administering, funding, and revising the Vegetation Plots Database.
11. Define the problem of sensitive data confidentiality in the Vegetation Plots Database and develop a proposed policy that addresses it.
12. Collaborate on the development and promotion of a model for maintaining a database of USVC community types that will assure long-term public access.

Introduction

In January of 1995, Ecological Society of America ([ESA](#)¹) President, Judy Meyer, appointed a [Panel on Vegetation Classification](#) (the “ESA Panel” or the “Panel”) to facilitate and support development of a standardized, scientifically credible vegetation classification system for the United States (referred to as U.S. Vegetation Classification, or USVC, also referred to in earlier work as the “National Vegetation Classification, or NVC). The USVC emerged in the late 1980s from the activities of The Nature Conservancy (TNC)² and the [Natural Heritage Network](#), largely with funding from Federal agencies.

Since its establishment, The Panel has: (1) provided detailed review, discussion, and advice to the Federal Geographic Data Committee ([FGDC](#)) on standards for vegetation classification; (2) developed new standards for the floristically-defined levels of the USVC; (3) established a Memorandum of Understanding ([MOU](#)) among ESA, FGDC, U.S. Geological Survey’s National Biological Information Infrastructure ([NBII](#)) and [NatureServe](#); and (4) undertaken development of a database system to support the USVC.

We are now entering a new phase of Panel activity, beyond initial development. This next phase is one that will implement the USVC. It requires that all parties reaffirm their roles and commitments to a unified conceptual and actual framework for the understanding of vegetation assemblages. As we enter this phase we need to carefully define the appropriate roles for the Panel (and thus ESA) and its partner organizations. The Panel’s geographic interests currently focus on the U.S., but the scope of the project remains at least North American and potentially broader.

The MOU signed by the ESA, FGDC, TNC and USGS provides insight to the broadly shared expectations of the Panel’s role. The main objectives of the Panel as articulated in the MOU are:

1. Refinement of a contemporary set of national vegetation classification standards, including both physiognomic and floristic levels.
2. Establishment of and open access to databases containing the full classification system, including the field plot data and methods used to define each accepted unit of vegetation.
3. Establishment and support of a review process for the accepted floristic units of the classification.

In the following section we identify our initial assumptions about the USVC. Following that, we discuss functions and roles as divided into three categories: (1) establishment and publication of standards, (2) review and publication of the classification and its named units, and (3)

¹ Underlined text indicates a hyperlink.

²In July 2000, The Nature Conservancy and the Natural Heritage Network established a new organization called the Association for Biodiversity Information ([ABI](#)), now called [NatureServe](#). The Conservancy’s science staff that helped develop the MOU and the U.S. National Vegetation Classification (see Grossman et al. 1998) transferred to NatureServe; thus NatureServe now represents the interests of the Conservancy in the MOU.

dissemination, archiving, and management of information. Issues relevant to each category are presented along with recommendations for addressing each issue.

The overall sequence of the three sections represents the logical continuum from conceptual development to implementation. Within these sections, we treat the issues concerning: (1) vegetation field plots and plot sampling; (2) standards for defining and describing vegetation associations and alliances that are quantitatively robust and peer reviewed (referred to here as “Strong” associations); and (3) standards for defining and describing associations and alliances having lesser documentation and review (“Moderate” and “Weak” associations). We also refer to a document nearing completion by the ESA Panel, “Standards for Floristic Vegetation Classification” (also called the “Standards” document).

Initial Assumptions

The USVC takes as its starting point the NatureServe (formerly TNC) classification that was adopted with modifications by the FGDC as a Federal standard known as the “National Vegetation Classification Standard” (FGDC 1997), and which is described as:

“The upper five physiognomic levels of the TNC standard (Class, Subclass, Group, Subgroup and Formation) are based on modifications by TNC Ecology Working Group of the UNESCO (1973) and Driscoll *et al.* (1984) vegetation classification. The lower two floristic levels (Alliance and Association) have been developed and are periodically enhanced by the ongoing work of TNC and the network of State Heritage Programs (TNC Ecology Working Group 1997 (in prep).” (FGDC 1997, p. 6)

With respect to the floristic levels of the classification, the FGDC chose to use the list published by TNC and the Natural Heritage Network (Anderson et al. 1998, Grossman et al. 1998). The FGDC’s expectation, though, is that “the data used to describe Alliance and Association types must be collected using uniform standard and documented sampling methods. The Alliance and Association units are derived from these field data” (FGDC 1997, p. 5). The NatureServe list of associations and alliances is a first approximation collated from many different sources. Although most types have been agreed to by NatureServe ecologists, many lack repeatable quantitative analysis and independent review. In their present form, many of the association descriptions would not conform to the standards for an accepted vegetation type that is now proposed for the USVC by the Panel and its partners. The Panel’s current activities and partnerships focus on associations and alliances with the intention of building on the work of NatureServe and the FGDC, progressing from the “first approximation” to a widely used system that is supported and continuously improved upon by the broad community of scientists and practitioners. The Panel expects to work with the FGDC and NatureServe toward adoption of standards and peer-reviewed descriptions of associations and alliances. The following assumptions provide the philosophical starting point for the design of an institutional architecture for the various components of the USVC (standards, structure, vegetation units, review, and data).

1. The USVC must be based fundamentally on floristic as well as physiognomic units of vegetation that conform to published standards.
2. The USVC floristic units must be based on field plot data that meet minimum standards.
3. The USVC must be open to change in the sense that any person (independently, or representing of some institution) is free to submit proposed additions and changes, and that the rules, standards and opportunities are the same for all potential contributors regardless of their institutional affiliations.
4. The USVC must have a formal impartial, scientifically rigorous peer review process for floristic units, whereby proposals to recognize new units or change accepted units are evaluated.
5. The USVC must have a formal review process for proposed revisions to both the hierarchical structure by which physiognomic units of vegetation are classified and the physiognomic units themselves.
6. The USVC system should be sufficiently robust, well documented, and in the public domain, that the loss of one of the supporting organizations from the collaborative effort (e.g., NatureServe, ESA, FGDC, USGS) would not result in failure or collapse of the USVC and its supporting database system.
7. As the leading society for professional ecologists in the U.S., the ESA brings significant expertise and credibility to the USVC. The Panel should play an integral role in crafting and maintaining a partnership of interested organizations for the purposes of developing, implementing, and maintaining the USVC.
8. The chief aim of the USVC is to support a better understanding of vegetation and to serve as a practical tool for the conservation and management of the nation's vegetation resources.

Functions and Roles

1. Setting standards

Setting standards is one of the roles that professional societies have traditionally assumed and which they typically do well because they are generally authoritative, deliberative, and scientifically objective, which results in their usually having substantial credibility. Without a body like the Panel setting standards, the USVC is unlikely to be viewed by the broader community of scientists and practitioners as scientifically objective, open and continuously improving, and it is unlikely to win widespread acceptance. Without such widespread acceptance the USVC cannot succeed as a unifying synthetic tool for solving problems of how and why plant species assemble into communities, what the functional properties of plant communities are, or how to better predict management outcomes.

Recommendation 1: The Panel should develop detailed operational classification standards and guidelines for the USVC. These standards and guidelines should address (a) definition and modification of floristic units; (b) the requirement that units be based on plot data; (c) the need for an open, scientifically rigorous decision process incorporating peer review; (d) requirements and mechanisms for publication of floristic unit descriptions; and (f) mechanisms for assuring the availability and dissemination of supporting data.

1.1 Establish and publish standards for plot data

The ESA Panel is currently developing standards for the field plot data needed to support the USVC. The draft standards can be found in the “Standards” document and in the design documents for the Vegetation Plots Database (Peet et al. 2000, 2001). Continued development and review of standards for plot data to support the USVC is a logical activity for the Panel.

Recommendation 2: The Panel should establish and publish standards for vegetation field plot data that would be required to support new or revised floristic units of the USVC.

1.2 Establish and publish definitions for acceptance levels that can be attributed to the descriptions of associations and alliances

A first approximation of associations and alliances for the USVC has been developed and published by NatureServe (Anderson et al. 1998, Grossman et al. 1998). Although this was the vital initiating activity for development of the USVC, these descriptions were developed in the absence of independent review for acceptance by a wider set of users.

In developing the first approximation of association and alliance descriptions, NatureServe scientists ranked the level of confidence that they had in each description. We propose adopting a similar approach by establishing three categories of acceptance that can be attributed to named floristic units. The most robust category, the one that demonstrates the highest level of confidence, would be termed “Strong.” Associations and alliances attributed to this category would meet strict standards of description and documentation, and would reference a set of field plot data available in digital form to anyone wishing to review the primary sources that were used to define the accepted types. A second category of associations and alliances, termed “Moderate,” would include those that are generally well documented and for which there is considerable certainty, but which lack some essential criteria required for highest level confidence in the type (the “Strong” status), such as field plot data needed to define the type numerically, or they may lack information on the compositional variation expressed by such a floristic unit across its geographic or environmental range.

Associations and alliances in the Strong and Moderate categories will be formally peer-reviewed. The third category is termed “Weak.” The Weak category would be applied to types described in a manner consistent with the proposed standards for Moderate or Strong status, but would not have been formally peer-reviewed. The peer-review process envisioned would have the ability to elevate Weak types to either Moderate or Strong status, or reject them as not being a formally recognizable type. Further details on these categories are provided in the Panel’s “Standards” manuscript.

We propose these three categories because in some cases it is necessary, as an interim measure, to develop descriptions of many associations and alliances that do not meet the strict standards for quantitative analysis and documentation required for recognition as Strong. The general shortage of field plot data for U.S. vegetation necessitates descriptions of plant communities that do not meet rigorous standards for plot-based characterization (or else the USVC will remain incomplete for a very long time).

Recommendation 3: The Panel should establish and publish detailed standards for designating confidence about a floristic unit as “Strong” based on strict standards of definition, documentation, review, and access to the primary field plot data. The Panel should also establish and publish standards for designating a floristic unit as a “Moderate” or as “Weak” based on less stringent requirements.

1.3 Standards for organism (particularly plant species) nomenclature as used in vegetation databases

Taxonomic nomenclature standards, especially for plant species, are needed to support vegetation classification and underlying plot data. Current taxonomic databases are inadequate in that they do not track differences in the taxonomic concepts; that is, they do not recognize that a simple reference to a Latin binomial can be ambiguous with respect to the intended circumscription or concept. This is especially important because the required plot data typically do not have associated voucher specimens of the inventoried taxa.

We recognize that taxonomic standards are best left to other professional organizations, such as the International Organization for Plant Information ([IOPI](#)), the Taxonomic Database Working Group ([TDWG](#)), the FGDC Biological Nomenclature and Taxonomy Working Group ([BNT](#)), the Integrated Taxonomic Information System ([ITIS](#)) partners, and especially the International Code of Botanical Nomenclature from the International Association for Plant Taxonomy ([IAPT](#)). However, taxonomic standards databases have not yet incorporated designs that adequately handle concept-based taxonomy (e.g. Berendsohn 1995, 1997, Zhong et al 1996) in place of name-based identification. The ESA Panel and its partners currently have the opportunity to work with the systematics community and FGDC in developing a concept-based approach for specifying the identities of taxa appropriate for merging databases collected at different places and at different times by different investigators.

***Recommendation 4:* The Panel should continue its collaboration with ITIS, FGDC, and NatureServe to encourage and facilitate timely development and implementation of standards for concept-based biological nomenclature that fulfills the informatics needs of the USVC and other ecologists involved in database integration.**

1.4 Evaluate and proposals for changes in classification groupings in the USVC above the floristic levels, and establish standards for their application

The Panel previously provided the FGDC Vegetation Subcommittee with an extensive review of the physiognomic classification. Since then the Panel's primary focus has been on the floristic units of the USVC. It is, however, important that the Panel continue this scientific advisory role and make recommendations to the FGDC pertaining to the ongoing improvement and updating of standards. It would be appropriate for the Panel to review guidelines for implementing the physiognomic levels of the USVC as well as proposals for their revision.

***Recommendation 5:* The Panel should evaluate, as needed, proposals for changes to the physiognomic levels of the USVC and, as appropriate, draft or review proposed changes to them.**

Further, the Panel may want to review alternative ways to aggregate associations and alliances into more general units. Associations are commonly grouped into more general units of vegetation in other classifications; for example, in Europe, the traditional Braun-Blanquet (1932) system is being implemented along side the more conservation-based approach of the European Nature Information System ([EUNIS](#); Mucina 1997, 2001, Rodwell et al. 1998). These multiple approaches imply that associations and alliances can be defined independent of any given hierarchy and that multiple hierarchies can support multiple user needs.

***Recommendation 6:* The Panel should review and evaluate, as needed, proposed alternative hierarchical classifications for application above the level of the association.**

1.5 FGDC and The Panel

The FGDC Vegetation Subcommittee is expected to play a significant role in the ongoing development, support, and maintenance of the USVC. They are a signatory to the MOU discussed above and bring significant federal participation to the effective implementation of the USVC through the many federal activities involved with vegetation resources. The ESA Vegetation Panel's relationship to the FGDC is to provide the FGDC with independent scientific review in support of credible federal standards for the U.S. vegetation classification and related standards.

The FGDC Vegetation Subcommittee, however, cannot be expected to move quickly when it comes to the ongoing development of floristic units, given the multiple parties and deliberative reviews that are needed to promulgate federal standards. Whereas the hierarchical classification and taxonomic units of the physiognomic categories are expected to be less dynamic than the floristic categories in the near future, a large number of proposals for new and revised alliance and association descriptions are likely for the indefinite future. Each of these will require review, discussion, and publication. At issue is how to configure and manage the interface between the rapid development and recognition of the floristic units in the context of the deliberative approach needed in the establishment of federal standards.

Recommendation 7: The Panel should support the activities of the FGDC by providing independent review and advice in support of their promulgation of standards. Toward this end, the results of Panel deliberations should be presented in a fashion appropriate for FGDC review and possible adoption.

2. Review and authenticate proposals for addition or modification of the associations and alliances recognized within the USVC

2.1 Establish and maintain a peer review process for proposed additions and changes to the set of community types accepted in the USVS in collaboration with partner organizations

A peer-review process for floristic units could follow either of two different procedural models: (1) the plant species list model, where each party selects its preferred types and maintains its own acceptance list and interpretation of synonymy, or (2) the North American bird species list model where a professional group (the American Ornithological Union) evaluates all proposals and approves changes in the recognized list.

The plant species list model is not desirable because it would provide neither the collaboration of efforts, nor an open system in which the broader scientific and applied community is encouraged to participate. We would like to see the ESA Panel collaborate with NatureServe, FGDC, and future partner organizations to establish and sustain a peer-review process for the maintenance and revision of a dynamic list of USVC accepted types.

The peer review process set out in the Panel's "Standards" document contains the basic set of rules by which vegetation types are first identified, recorded, formally described, and reviewed. However, the nature of the peer review process that would best serve the creation and maintenance of a national list of associations and alliances needs further collaborative development.

Recommendation 8: The Panel should collaborate with partner organizations to establish and maintain an efficient peer-review process for proposed additions, deletions, and changes to a set of accepted community types.

2.2 Collaborate to establish and manage, in concert with the peer review process, an e-journal for monographic treatment of accepted vegetation types

Currently, descriptions of associations and alliances in the USVC are maintained on the NatureServe web site (www.natureserve.org). These descriptions are not presently subject to peer review or a consistent process for resolving competing nomenclatures. The descriptions include references to the primary and secondary literature upon which they are based, but do not include field data or analyses of field data. In short, a conspicuous problem with the USVC as it currently exists is that there is no publicly accessible primary literature. Although we accept this as an unavoidable initial condition, in order to implement the USVC envisioned here a vehicle must be provided for publicly accessible, peer-reviewed primary literature of type descriptions that users can refer to when checking the basis for (or attributes of) particular accepted vegetation types.

An electronic journal (a “Proceedings,” or “Annals”) could contain records of successful proposals for changes in the USVC, together with the rationale presented to reviewers. This type of journal could be generated in an automated fashion based on digital submissions to the review body. The component articles would directly link to relevant data in the Plots Database (see section 3.1).

Recommendation 9: The Panel should seek establishment of an electronic journal, , through which to publish the basis for revisions to the accepted associations and alliances in the USVC.

3. Building and managing databases

3.1 Manage an ESA Vegetation Plots Database

At the core of the proposed standards for the floristic units is the need for a readily usable and accessible database that archives and disseminates vegetation plot information. This database would provide a repository for all plots collected and used to document associations and alliances in the USVC. Without this tool, the ability to set strict standards for defining floristic units will be seriously impaired.

The ESA Panel is currently building a U.S. Plots Database with funding from the National Science Foundation, USGS, and NCEAS. The project is based at NCEAS (Peet et al. 2000, 2001). Although no other group appears to have undertaken a similar activity, many have indicated that it would meet significant needs. For example, submission and citation of plot data might be expected to function rather like [GenBank](#)

where workers deposit raw descriptive data and routinely cite it in publications via an accession number. Initially the database could be run for a minimal cost. However, we anticipate that within several years maintenance would require a funding base that would support one full-time position. A business plan must be developed to support the database. Ultimately the database could (or should) be supported and maintained by USGS, though alternatively ESA could manage the Plots Database through user fees and grant funds. The Panel is committed to and confident in its ability to raise the necessary funds for this activity for the first several years of implementation. Since 1995 the Panel has raised \$676,996 for its operations.

There remain serious issues about how to manage sensitive information that will occur in the plot data. Examples of sensitive information include confidentiality about attributes of privately owned land, and locations of species populations that are rare or subject to collecting pressures. It is vital that such information be managed to prevent loss of confidentiality or injury to the resource.

***Recommendation 10:* The Panel should continue and expand collaborative efforts to develop and implement plans for launching, administering, funding, and periodically evaluating the US Vegetation Plots Database.**

***Recommendation 11:* The Panel should define and resolve the problem of data sensitivity associated with serving a US Plots Database.**

3.2 Collaboratively develop and maintain a publicly accessible database of accepted and candidate communities

For a vegetation classification scheme to be successful, it must be widely accessible to the user community. Toward this end, the Panel should work with NatureServe to ensure a web-based, publicly accessible database of the accepted types and their attributes, since NatureServe already maintains the web site of alliances and associations.

***Recommendation 12:* The Panel should work with NatureServe and FGDC to promote a model for maintaining a database of accepted community types (and their critical attributes) that will assure easy and long-term public access.**

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