VegBank and the NVC

- Ecologists have long recognized need to communicate about "community type" or "vegetation type" as a unit of vegetation.
- Vegetation types can be understood as segments along gradients of vegetation composition – more-or-less continuous.
- Conceptualization of vegetation types is derived from analyses of vegetation samples (plots, transects, relevés etc.), and these samples provide the fundamental records for describing vegetation.
- Both basic and practical needs for classifying vegetation have led to substantial unification in approaches to vegetation classification – the NVC is one such expression.
- Convergence of basic concepts that underlie establishment and recognition of associations and alliances.
Biodiversity data structure

- Locality
- Plot Observation/Collection Event
- Specimen or Object
- Bio-Taxon
- Vegetation Type
- Vegetation classification databases
- Plot/Archive databases
- Specimen databases
- Taxonomic databases
Classification Database

Classification Mgmt.

US-NVC Panel

Proposal

Analysis & Synthesis

Vegetation Plot Archive

WWW Output

Extraction

Digital NVC Proceedings

Peer Review

Legend
- External Action
- Internal Action
- Database

Proposed data flow
Vegetation Plot Archive: A Missing Piece of the Puzzle

The missing core component is the data infrastructure needed to manage the anticipated $10^7$ plots and $10^4$ plant associations, and to distribute this over the web in a continually revised, perfectly updated form.

But how were we getting by before?
Database Solutions to Plot Archives and Other Databases for NVC

Plot data form the quantitative basis for refining the NVC/IVC classification – but they depend on other data and databases.

Plot Data require 3 key databases:

- Classification Databases
  - *Biotics, NatureServe Explorer*
- Taxonomic Databases
  - *ITIS, others*
- Vegetation Plot Databases
  - *VegBank, VegBranch, others*?
Other Pieces Needed for NVC

But processing of plot data for IVC/NVC also needs another set of processes for interpretation of vegetation types based on plots.

1. Consistent Type Description
2. Peer Review Process
3. NVC Digital Proceedings connecting Type descriptions to Plot database.
VegBank – the Plot Archive Solution

• The ESA Vegetation Panel is currently developing a public vegetation plot archive known as VegBank (www.vegbank.org).

• *VegBank* is expected to function for vegetation plot data in a manner analogous to *GenBank*.

• Primary data will be deposited for reference, novel synthesis, and reanalysis, particularly for classification.

• The database architecture can be generalized to most types of species co-occurrence data.
VegBank
A vegetation field plot archive

Sponsored by:
The Ecological Society of America - Vegetation Classification Panel

Produced at:
The National Center for Ecological Analysis and Synthesis (NCEAS)

Principal Investigators:
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VegBank is made possible by the support and cooperation of:

- Ecological Society of America
- National Center for Ecological Analysis and Synthesis
- Federal Geographic Data Committee
- Gap Analysis Program
- National Biological Information Infrastructure
- National Science Foundation
- NatureServe
Core elements of VegBank

- Plot data
- Species taxonomy
- Vegetation classification

*Plot Interpretation (Community Type)*

**Diagram:**
- Project
- Plot
- Plot Observation
- Taxon Observation
- Taxon Interpretation

*NatureServe*
The Taxonomic Database Challenge: *Standardizing organisms and communities*

**The problem:**
Integration of data potentially representing different times, places, investigators and taxonomic standards.

**The traditional solution:**
A standard list of organisms / communities.
Taxon: Standard Lists are Available

Representative examples for higher plants include:

* **North America / US**
  - USDA Plants  http://plants.usda.gov/
  - ITIS  http://www.itis.usda.gov/
  - NatureServe  http://www.natureserve.org

* **World**
  - IPNI International Plant Names Checklist  http://www.ipni.org/
  - IOPI Global Plant Checklist  http://www.bgbm.fu-berlin.de/IOPI/GPC/
Most standardized taxon lists fail to allow effective integration of datasets

The reasons include:

• Taxonomic concepts are not defined (just lists),
• Multiple party perspectives on taxonomic concepts and names cannot be supported or reconciled,
• The user cannot reconstruct the database as viewed at an arbitrary time in the past.
Why current taxon lists fail: Three concepts of shagbark hickory

Splitting one species into two illustrates the ambiguity often associated with scientific names. If you encounter the name “Carya ovata (Miller) K. Koch” in a database, you cannot be sure which of two meanings applies.

Carya ovata (Miller)K. Koch

Carya carolinae-sept. (Ashe) Engler & Graebner

Carya ovata (Miller)K. Koch

sec. Gleason 1952

sec. Radford et al. 1968
A **concept** represents a unique combination of a **name** and a **reference**

“Taxon Concept” is equivalent to “Potential taxon” & “Assertion”
What we wished was available: (Inter)National Taxonomic Database

An upgrade for ITIS etc.?

- Concept-based
- Party-neutral
- Synonymy and lineage tracking
- Perfectly archived
Plot Database Conclusions

1. A public archive is needed for vegetation plot data.
2. Design for re-observation of plots: separate permanent from transient attributes.
3. Records of species should always contain a scientific name and a reference (concept-based).
4. Design for future annotation of species and community concepts.
5. Archival databases should provide time-specific views.
Guidelines for Vegetation Classification

The ESA Vegetation Panel and its partners have been working to develop guidelines for the floristic levels of the classification covering:

- Terminology
- Plot data acquisition
- Identification and documentation of vegetation types
- Formal description and peer review of types
- Information dissemination and management.

Version 2.0 released in May 2003
Version 3.0 under review by FGDC as federal standard
ESA standards for plot data

Four levels of standards:
- Submission (geo-coordinates, dominant taxa)
- Occurrence (area, interpretation)
- Classification (cover values for all taxa)
- Best practice (cover values for all taxa by strata)

Pick lists (48 and counting)

Conversion to common units

Method protocols

Concept-based interpretations of taxa & communities

“Painless” metadata
Vegetation Description

Pseudotsuga menziesii – Tsuga heterophylla Forest Alliance
Douglas Fir – Western Hemlock

CANOPY SPECIES
• *Pseudotsuga menziesii* 37.5%
• *Abies grandis* 37.5%
• *Tsuga heterophylla* 37.5%
• *Thuja plicata* 12.5%

Olympic National Park, Mt. Olympus
Vegetation Description: structure & floristics

T – TREE LAYER (100%)
T1 (main canopy layer; 100%):
• *Pseudotsuga menziesii* 37.5%,
• *Abies grandis* 37.5%,
• *Tsuga heterophylla* 37.5%,
• *Thuja plicata* 12.5%;
T2 (sub canopy layer; 70%):
• *Tsuga heterophylla* 12.5%
• *Acer circinatum* 62.5%,
• *Rhamnus purshiana* 3%;

S – SHRUB LAYER (20%)
S1 (tall shrub layer; 15%):
• *Taxus brevifolia* 0.5%,
• *Oplopanax horridus* 7.5%,
S2 (low shrub layer; 20%):
• *Mahonia nervosa* 3%,
• *Gaultheria shallon* 12.5%, etc.

H - HERB LAYER (50%): 
M - MOSS LAYER (70%).
VEGETATION FIELD PLOTS
(Guidelines, Chapter 5)

1. Stand selection and plot design: How plots/stands were selected and designed.

2. Physiognomy: (Optimally), recognize the following strata when present: tree, shrub, herb, and moss (moss, lichen, liverwort, alga), and in aquatic habitats, floating, and submerged

3. Species composition:
   • Sampling should detect complete species assemblage (one time sampling)
   • A plant name and plant reference
   • Taxon cover (or taxon stratum cover); cover estimated to at least Braun-Blanquet scale.
VEGETATION FIELD PLOTS
(Guidelines, Chapter 5)

4. Site data: Elevation, slope aspect, slope gradient. (minimal).

5. Geographic Data:
   • Latitude and longitude, decimal degrees and WGS 84 (NAD83) datum,
   • Field coordinates and the datum used.

6. Metadata: Project name/description, methodology for selecting and laying out plots, effort in gathering floristic data, cover scale and strata types, and name/contact information of lead field investigators.
DESCRIPTION OF FLORISTIC UNITS
(Guidelines, Chapter 6)

1. Names of natural and semi-natural types (nomenclatural rules).
2. Floristic unit. Indicate level of unit described: “Association,” “Alliance,” “Planted/Cultivated.”
3. Placement in the hierarchy
4. Classification comments.
5. Rationale for choosing the nominal taxa (the species by which the type is named).
7. Physiognomy.
8. Floristics. Species composition and average cover for all species (preferably by stratum)
   a. Stand table of floristic composition (preferably by stratum)
   b. Summary of diagnostic species.
   c. Taxonomic usage in floristic tables with reference.
DESCRIPTION OF FLORISTIC UNITS
(Guidelines, Chapter 6)

9. Dynamics
10. Environmental description.
11. Description of the range
12. Identify field plots.
13. Evaluate plot data
14. The number and size of plots. Justify the number of and sizes of plots.
15. Methods used to analyze field data.
16. Overall confidence level for the type (High, Moderate, Low).
17. Citations.
18. Synonymy.
GUIDELINES FOR PEER REVIEW
(Guidelines, Chapter 7)

1. Peer-review process administered by the ESA Vegetation Panel and appointees.
2. Reviewers should have sufficient regional expertise.
3. Each type will be assigned a confidence level (High, Moderate, Low).
4. Investigators participating in NVC use a defined template for type descriptions.
5. Investigators must place their proposed types within context of existing NVC types – decide if proposed type is distinct, or will refine or upgrade existing type(s) on list.
6. Two kinds of peer review are available.
   a. Types with information sufficient for High or Moderate confidence level, full peer-review process required.
   b. Types with less information, but investigator is convinced type is new to NVC, s/he submits as Low confidence, expedited peer-review process.

7. Full descriptions of types constitutes the NVC primary literature, published in a public digital Proceedings of the NVC.
DATA MANAGEMENT
(Guidelines, Chapter 8)

1. Vegetation Classification Database viewable and searchable over the web. Primary access - NatureServe Explorer (http://www.natureserve.org/explorer/).
2. Users of NVC should cite the website and the explicit version observed.
3. Maintenance of NVC data files by NVC management team. However, definition, redefinition, or change in the confidence level of a vegetation type requires approval of the peer-review team.
4. Plot data for NVC must be archived in VegBank or other public database.
5. Plot data for NVC types must be linked by accession number to types in the Vegetation Classification Database and should be publicly available.

6. If non-VegBank database used, that archive must ensure data permanency and exportability.

7. Proposals for revisions to NVC submitted in digital format using standard templates.

8. Successful proposals posted on the web as Proceedings of the NVC.

9. Each taxon must be reported as a name and publication couplet. Unknown or irregular taxa should also be reported.
Proposed data flow

US-NVC

WWW Output

Extraction

Classification Database

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Plot Data
Core elements of VegBank

- Plot data
- Species taxonomy
- Vegetation classification

Diagram:

- Project
- Plot
- Plot Observation
- Plot Interpretation (Community Type)
- Taxon Observation
- Taxon Interpretation
Plot Data – Data Entry & Management

Multiple Options:

- Excel spreadsheets – VegBranch
- Access database - VegBranch
- NPS PLOTS database
- VegBranch
- Other Databases – XML links
DATA UPLOAD & DOWNLOAD

1. VegBranch → XML → VegBank

2. VegBank → SQL file → VegBranch

3. Other Databases ↔ XML ↔ VegBank
VegBank Client Interface Tools

- Desktop client for data preparation (VegBranch),
- Flexible data import,
- Standard query, flexible query, SQL query,
- Flexible data export,
- Tools for linking taxonomic and community concepts,
- Easy web access to central archive.
Connectivity of Databases

CE = Community Element Record
SP# = Species Record
= One Way Data Flow
= Deep Link

BIOTICS Community Element Data
Community ID - 1000
Name – Abies lasiocarpa- Vaccinium scoparuma Forest

Component SP
SP ID Name etc
1blah
2etc.
3

Plot Table
Asc# Type Date etc
1Typal xxx
2notype

Kartesz Data Tool

NS Explorer
Community ID - 1000
Name – Abies lasiocarpa- Vaccinium scoparuma Forest

Component SP
SP ID Name etc
1blah
2etc.
3

Plot Table
Asc# Type Date etc
1Typal xxx
2notype

VEG BANK – Plots
Accession # 1

Community ID - 1000
Name Abies lasiocarpa- Vaccinium scoparuma Forest

Plant List
SP ID Name cover etc.
100
200
300
400

CE 3000
CE 2000
CE 1000
Sp300
Sp200
Sp100

Sp300
Sp200
Sp100

Kartesz
Data Tool

B?

CE 3000
CE 2000
CE 1000
Sp300
Sp200
Sp100

D
Building Vegetation Datasets with VegBank

How will ecologists in universities, heritage programs, federal agencies, etc. be able to move their data into VegBank?

1. Why do it?
2. How to do it?
3. When to do it?
OTHER APPLICATIONS

Massive plot data have the potential to create new disciplines and allow critical syntheses.

• Remote sensing. What is really on the ground?
• Theoretical community ecology. Who occurs together, and where, and following what rules?
• Monitoring. What changes are really taking place in the vegetation?
• Restoration. What should be our restoration targets?
• Vegetation & species modeling. Where should we expect species & communities to occur after environmental changes?
LONG TERM USE & DATA MIGRATION PLANS

1. Sustainable Support for VegBank
2. Partnership among supporters of NVC based on plot data and NVC process
3. Compiling Data Sets