Mapping the Vegetation of National Parks Using Standard Ecological Classifications

Judy Teague, Rickie White, Pat Comer

NatureServe

With graphics and content contributions from USGS Upper Midwest Environmental Science Center, the Center for Remote Sensing and Mapping Science at University of Georgia, and the Virginia Natural Heritage Program

NatureServe

A Network Connecting Science With Conservation

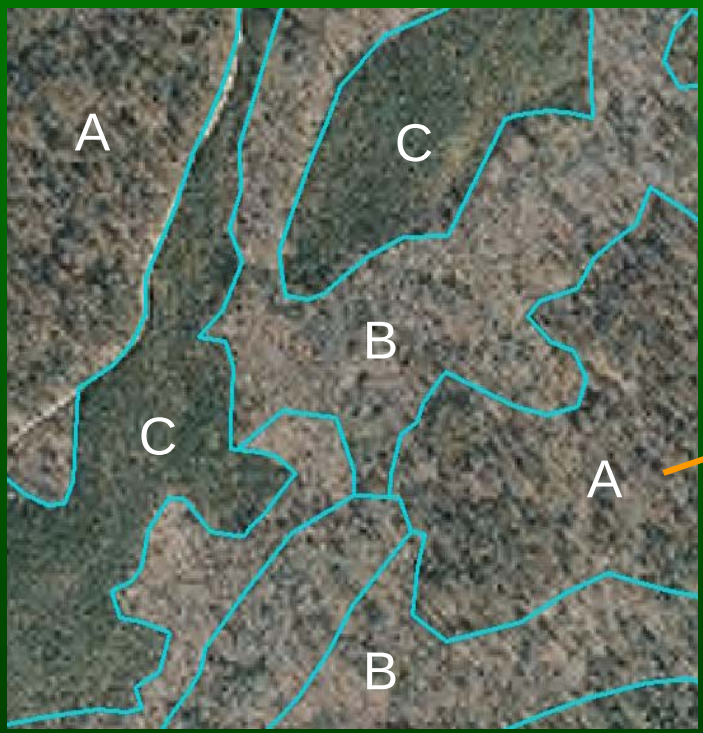
Presentation Summary

- Why Use Standard Ecological Classifications
- What are Standard Ecological Classifications
- US National Park Service Vegetation Mapping Program
- How Vegetation Maps are Used
- Ecological Classification Methodology
- Mapping Methodology

Why Use a Standardized Ecological Classification?

- Provides consistent names and concepts
- Identifies range-wide variability of types
- Needed to assess rarity and threats to determine conservation status

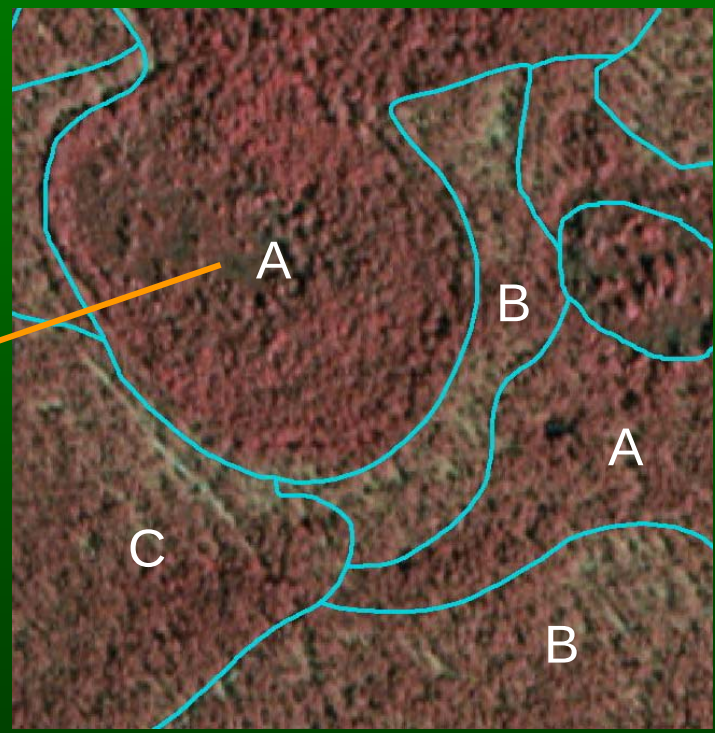
Provides
Consistent Concepts and Names



Park X

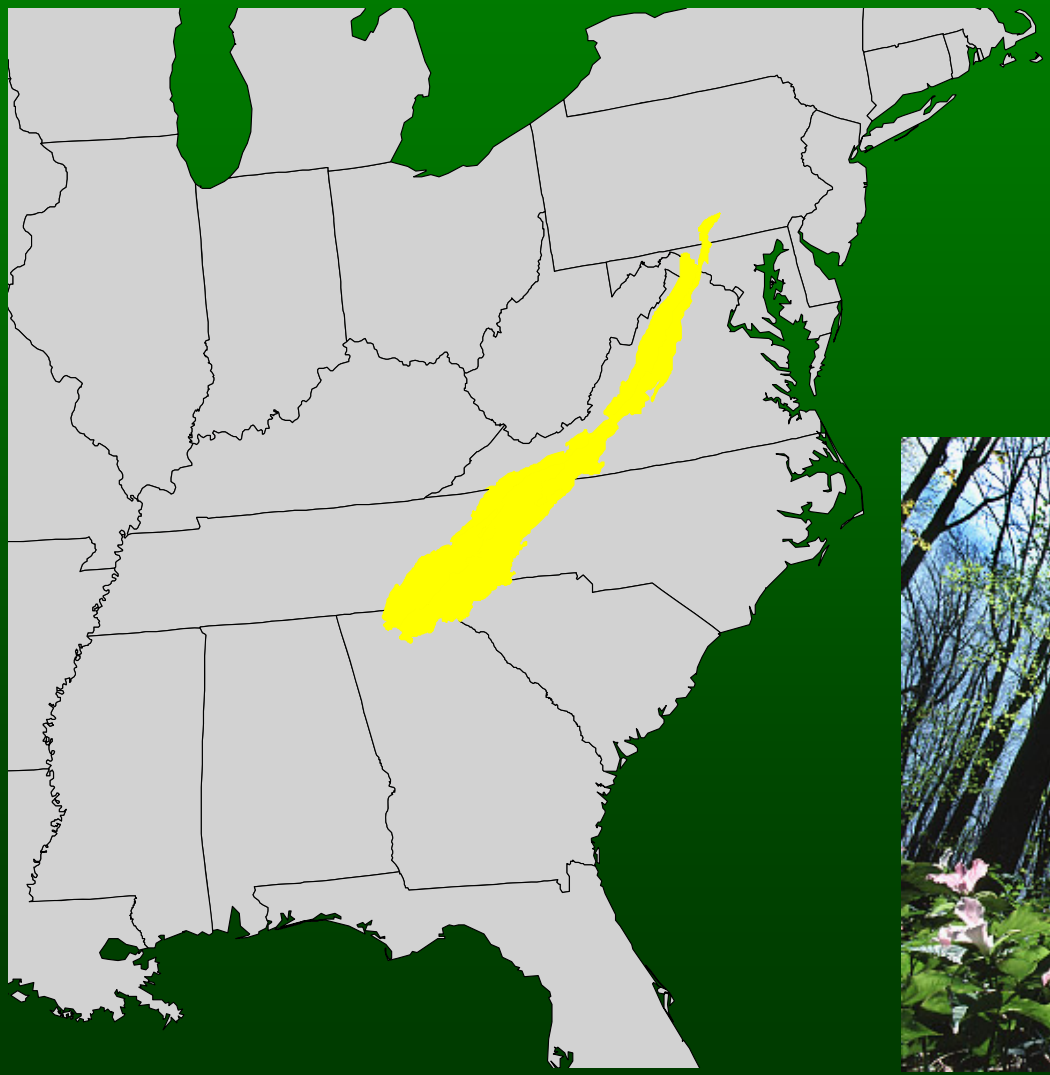
Same

Or Different?



Park Y

Range-wide Variability



Southern Appalachian Cove Forest (Typic Montane Type)

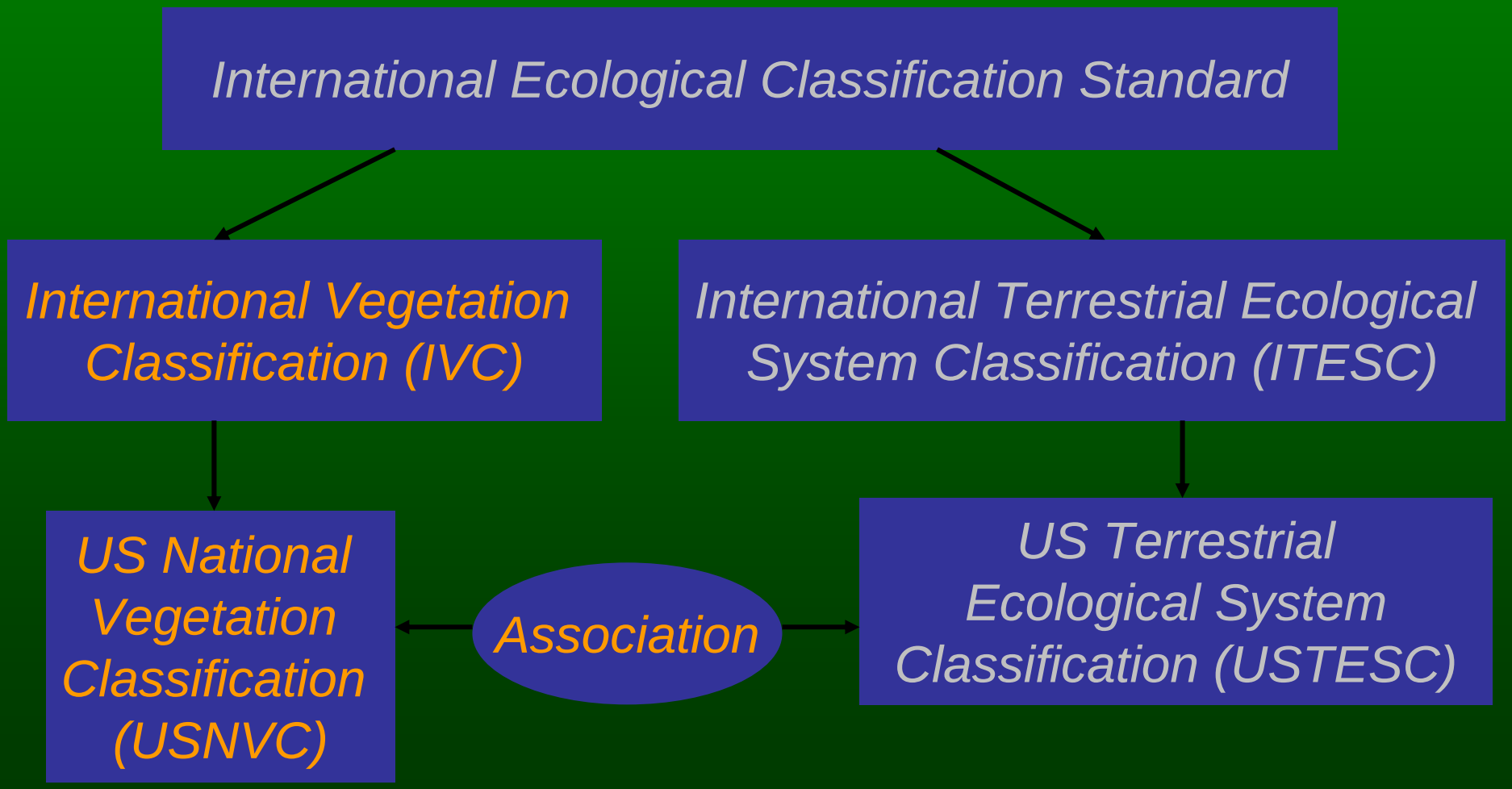
Global Conservation Status Ranks

G1 — Critically imperiled
G2 — Imperiled
G3 — Vulnerable
G4 — Apparently secure
G5 — Secure

GX — Presumed extinct
GH — Possibly extinct

Types of Standard Ecological Classifications

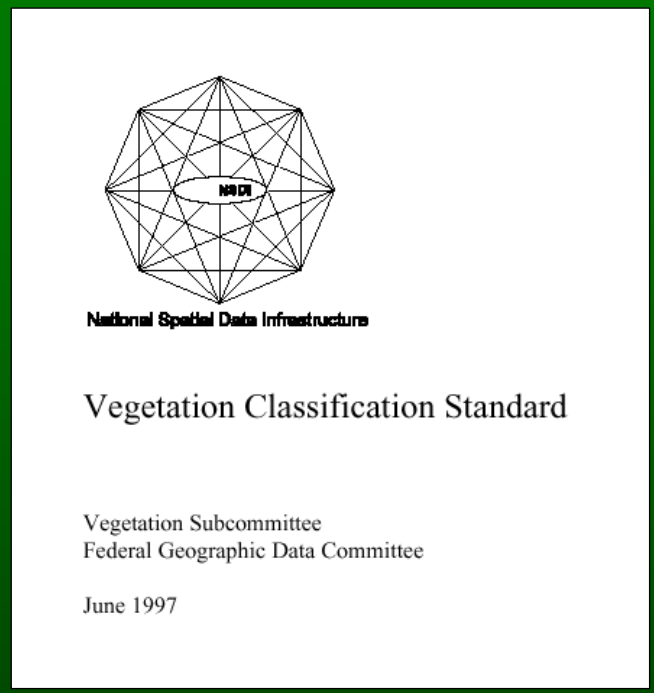
(Developed by NatureServe)



What do we mean by Standard?

US National Vegetation Classification

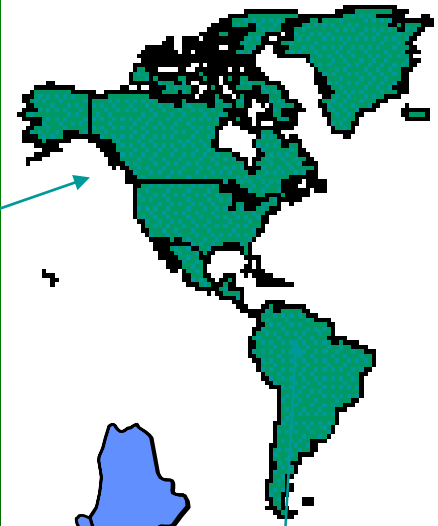
- *Ecological Society of America* (ESA) – data collection, analysis, peer review
- [U.S.] *Federal Geographic Data Committee* (FGDC) – inventory, mapping and reporting



Terrestrial Ecological System Classification

- Adopted by LANDFIRE
- Adopted by Andes-Amazon Moore Foundation Project

International Vegetation Classification



CNVC

USNVC

Western Region

Midwestern Region

Eastern Region

Southeastern Region

Latin American Classifications

National Vegetation Classification Formation Classes

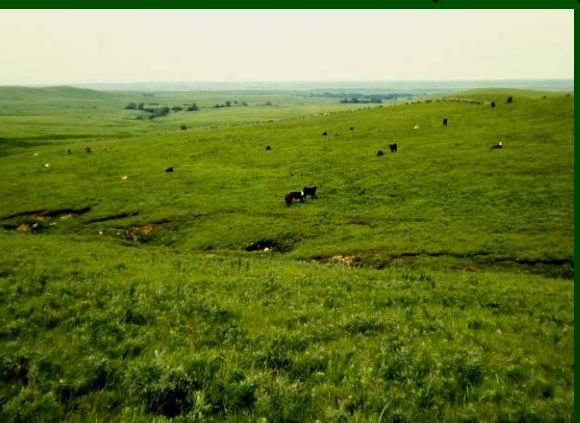
Forest (>60% tree canopy [>5 m])

Woodland (25-60% canopy)

Shrubland (0.5-5m h.)
(25-100% shrub canopy)

Dwarf-shrubland (<0.5 m h)

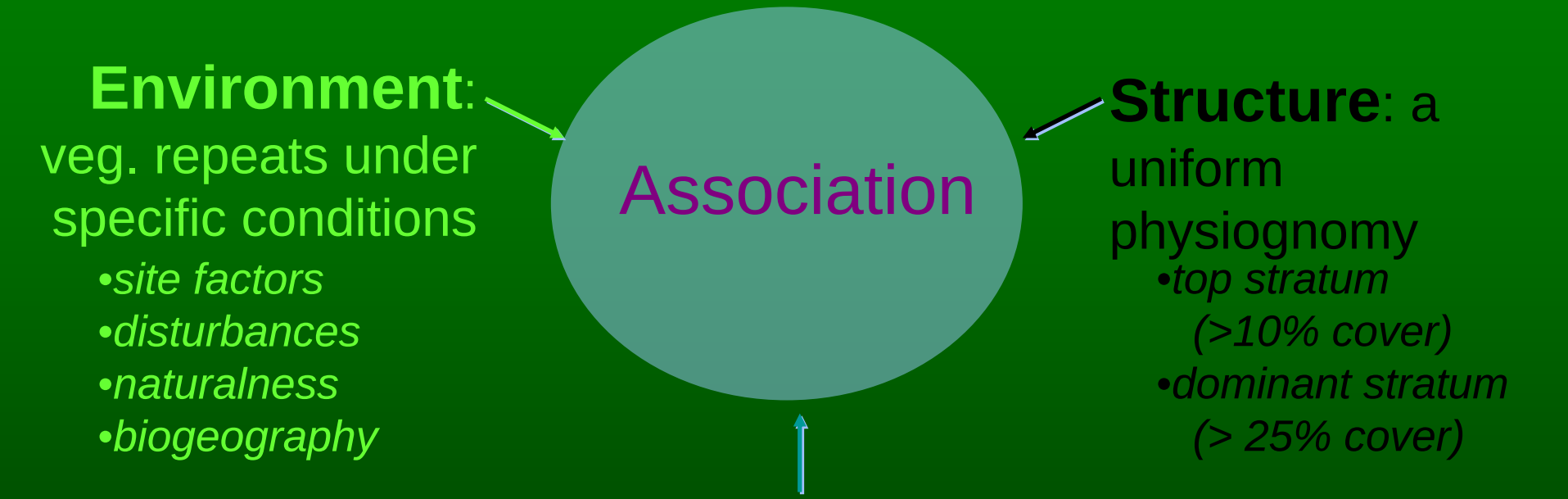
Herbaceous (>10%)



Nonvascular (Dominant)

Sparse (<10%)

National Vegetation Classification, Association



Environment: veg. repeats under specific conditions

- *site factors*
- *disturbances*
- *naturalness*
- *biogeography*

Structure: a uniform physiognomy

- *top stratum (>10% cover)*
- *dominant stratum (> 25% cover)*

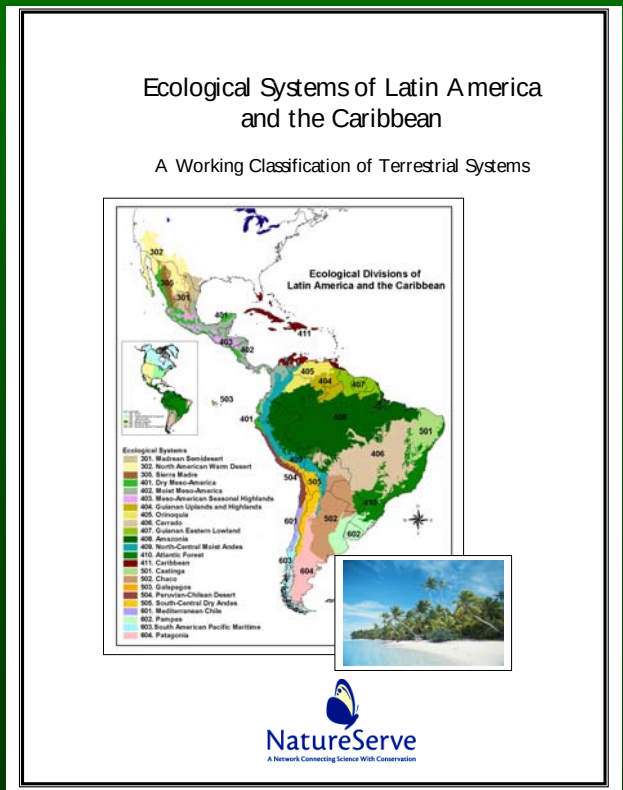
Floristics:

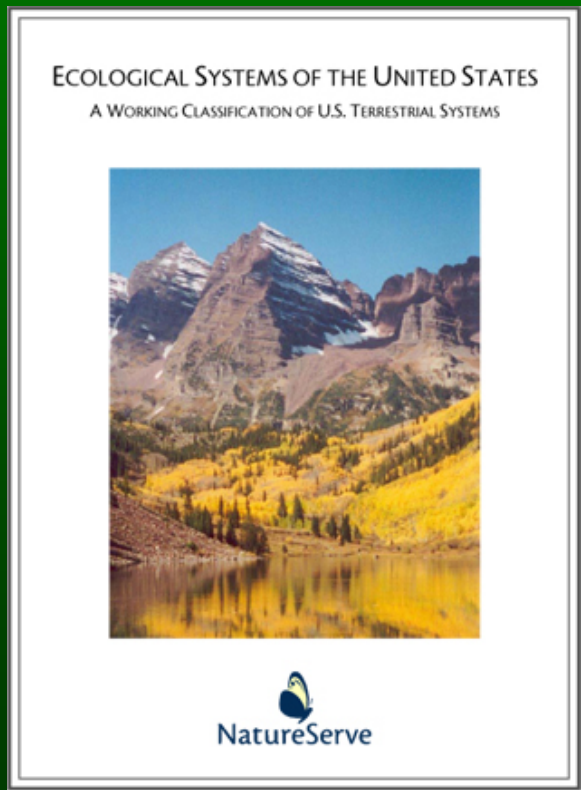
consistent composition across all strata

- *dominant species*
- *diagnostic (characteristic) species*

Terrestrial Ecological System

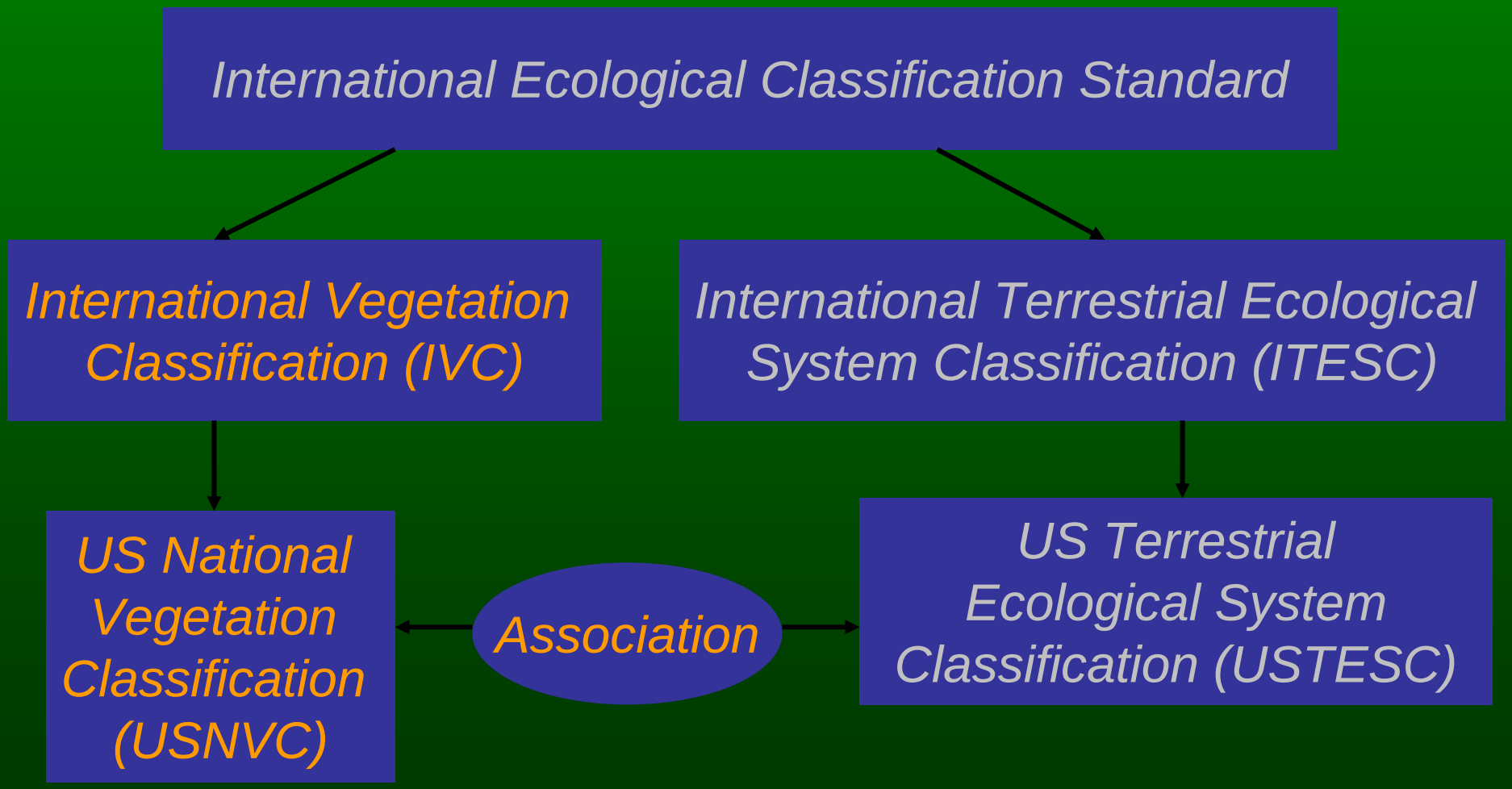
Group of associations that tend to co-occur within landscapes with similar ecological processes, substrates, and/or environmental gradients.





Types of Standard Ecological Classifications

(Developed by NatureServe)



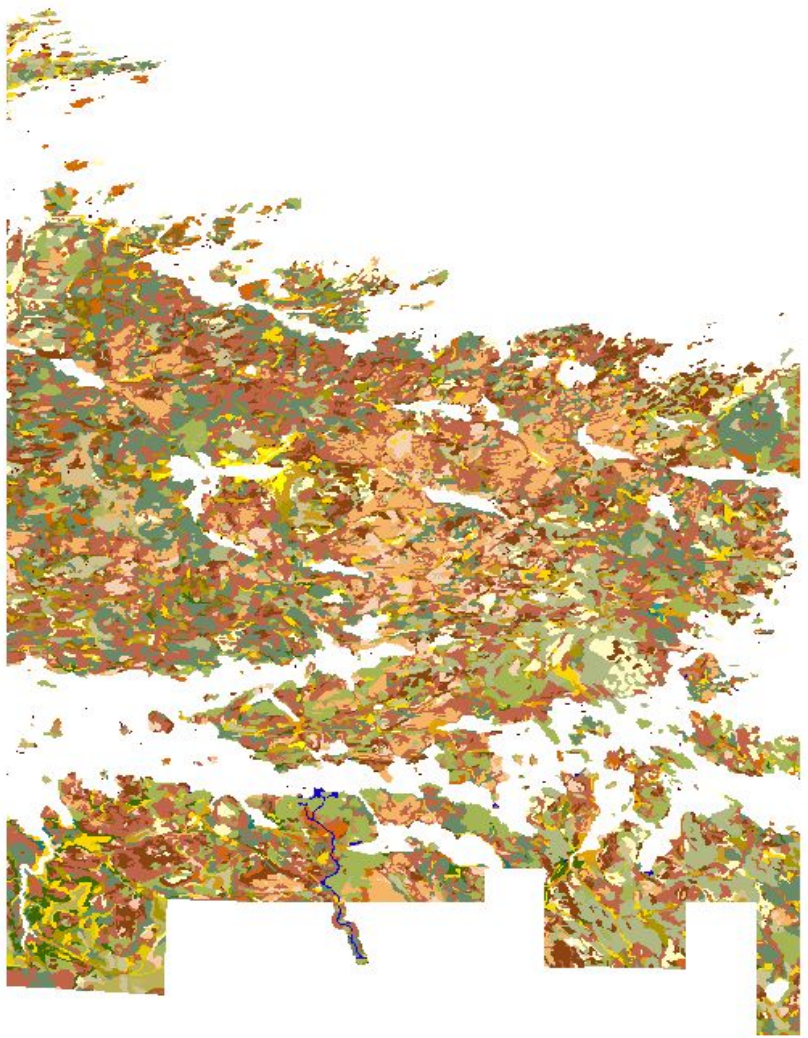
Associations (Finer Level)

(45 Associations)

List of associations

VOYA Associations
- Northern Water Lily Aquatic Wetland
- Midwest Pondweed Submerged Aquatic Wetland Association
- Black Spruce Bog
- Leatherleaf Bog
- Black Spruce / Leatherleaf Sem-Treed Bog
- Bog Birch - Willow Shore Fen
- Leatherleaf - Sweet Gale Shore Fen
- Tamarack Scrub Poor Fen
- Freshwater Bulrush Marsh
- Eastern Reed Marsh
- Midwest Cattail Deep Marsh
- Wild Rice Marsh
- Canada Bluejoint Eastern Meadow
- Black Ash - Mixed Hardwood Swamp
- Dogwood - Pussy Willow Swamp
- Black Spruce / Alder Rich Swamp
- Northern Tamarack Rich Swamp
- Black Spruce / Labrador Tea Poor Swamp
- Speckled Alder Swamp
- White Cedar - (Mixed Conifer) / Alder Swamp
- White Cedar - Black Ash Swamp
- Poverty Grass Granite Barrens
- Boreal Hazelnut - Serviceberry Rocky Shrubland
- Mixed Aspen Rocky Woodland
- Jack Pine / Lichen Rocky Barrens
- Boreal Pine Rocky Woodland
- Northern Pin Oak - Bur Oak - (Jack Pine) Rocky Woodland
- Jack Pine / Balsam Fir Forest
- Black Spruce / Feathermoss Forest
- Red Pine / Blueberry Dry Forest
- White Pine - Aspen - Birch Forest AND/OR Red Pine - Aspen - Birch Forest
- White Pine / Mountain Maple Mesic Forest
- Spruce - Fir - Aspen Forest AND/OR Black Spruce - Aspen Forest
- Spruce - Fir / Mountain Maple Forest
- White Cedar - Boreal Conifer Mesic Forest
- White Cedar - Yellow Birch Forest
- Aspen - Birch / Boreal Conifer Forest AND/OR Aspen - Birch - Red Maple Forest
- Paper Birch / Fir Forest
- Trembling Aspen - Balsam Poplar Lowland Forest
- Northern Bur Oak Mesic Forest
- Mosaic (3 saturated Dwarf-shrubland Associations AND 3 wetland Herbaceous Associations)
- Mosaic (Jack Pine / Balsam Fir Forest Association AND Quaking Aspen - Paper Birch Forest Alliance)
- Mosaic/Complex (5 wetland Herbaceous Associations)
- Mosaic/Complex (7 wetland Herbaceous Associations)
- Small Island with Vegetation
- Lakes, Ponds, and Streams (non-NVCS)
- Land Use (non-NVCS)

N



Voyageurs National Park, Minnesota

Ecological Systems (Coarser Level)

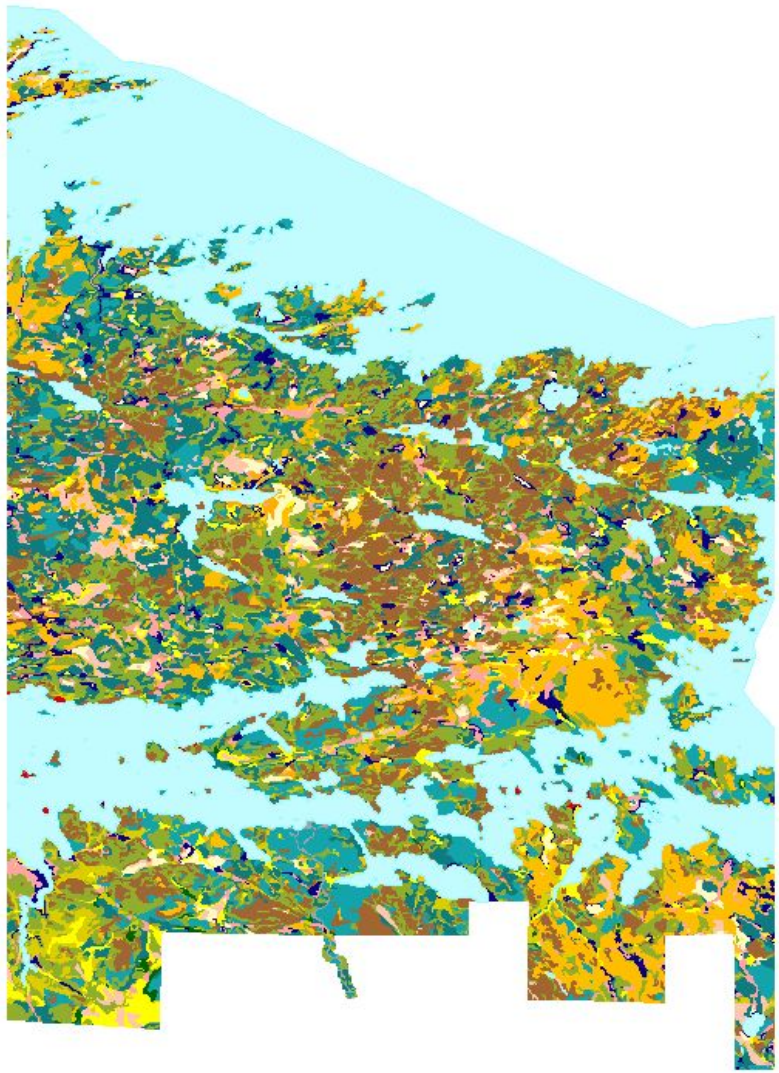
(20 Systems)

List of ecological systems

VOYA Ecological Systems Level 4

- Northern Conifer Bogs and Poor Swamps
- Northern Shrub/Graminoid Bogs and Poor Fens
- Northern Shore Fens
- Eastern Wide-ranging Open Marshes and Ponds
- Eastern Wide-ranging Emergent Marshes
- Northern Wet Meadows
- Northern Rich Conifer Swamps
- Northern Rich Hardwood Swamps
- Northern Rich Shrub Swamps
- Northern Acid Rock Outcrops/Barrens
- Northern Mesic Jack Pine and Black Spruce Forests and Woodlands
- Northern White Pine-Red Pine Forests and Woodlands
- Northern White Spruce-Fir Forests
- Northern Aspen-Birch Forests and Woodlands
- Northern Mesic Conifer-(Hardwood) Forests
- Northern Great Plains Bur Oak Forests and Woodlands
- Lakes and Streams
- Small Islands
- Small Natural Ponds
- Developed Lands

N



Voyageurs National Park, Minnesota

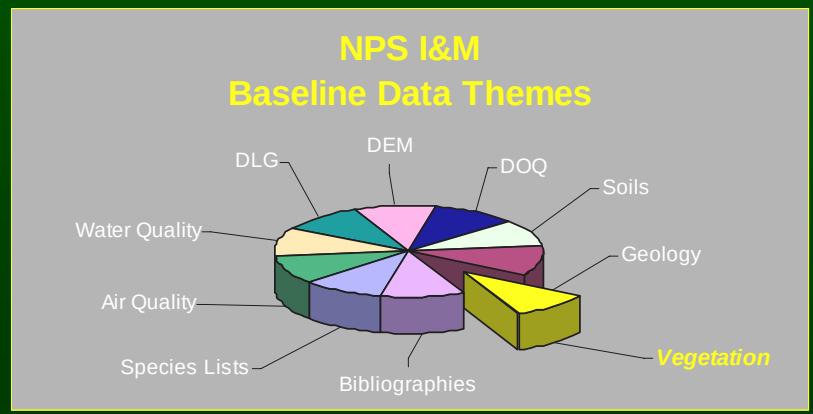
Presentation Summary

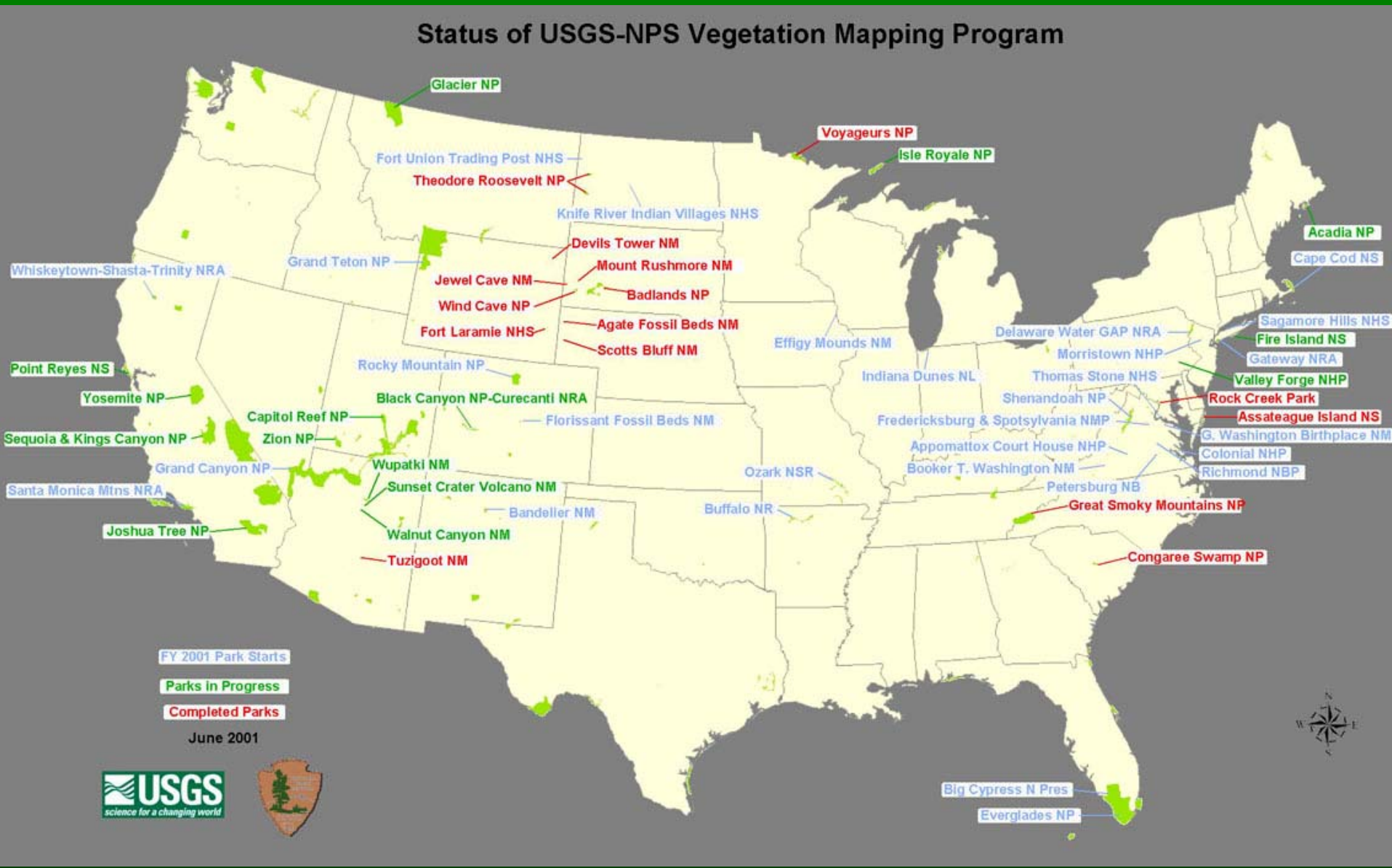
- Why Use Standard Ecological Classifications
- What are Standard Ecological Classifications
- US National Park Service Vegetation Mapping Program
- How Vegetation Maps are Used
- Ecological Classification Methodology
- Mapping Methodology

NPS-USGS Vegetation Mapping Program Goals

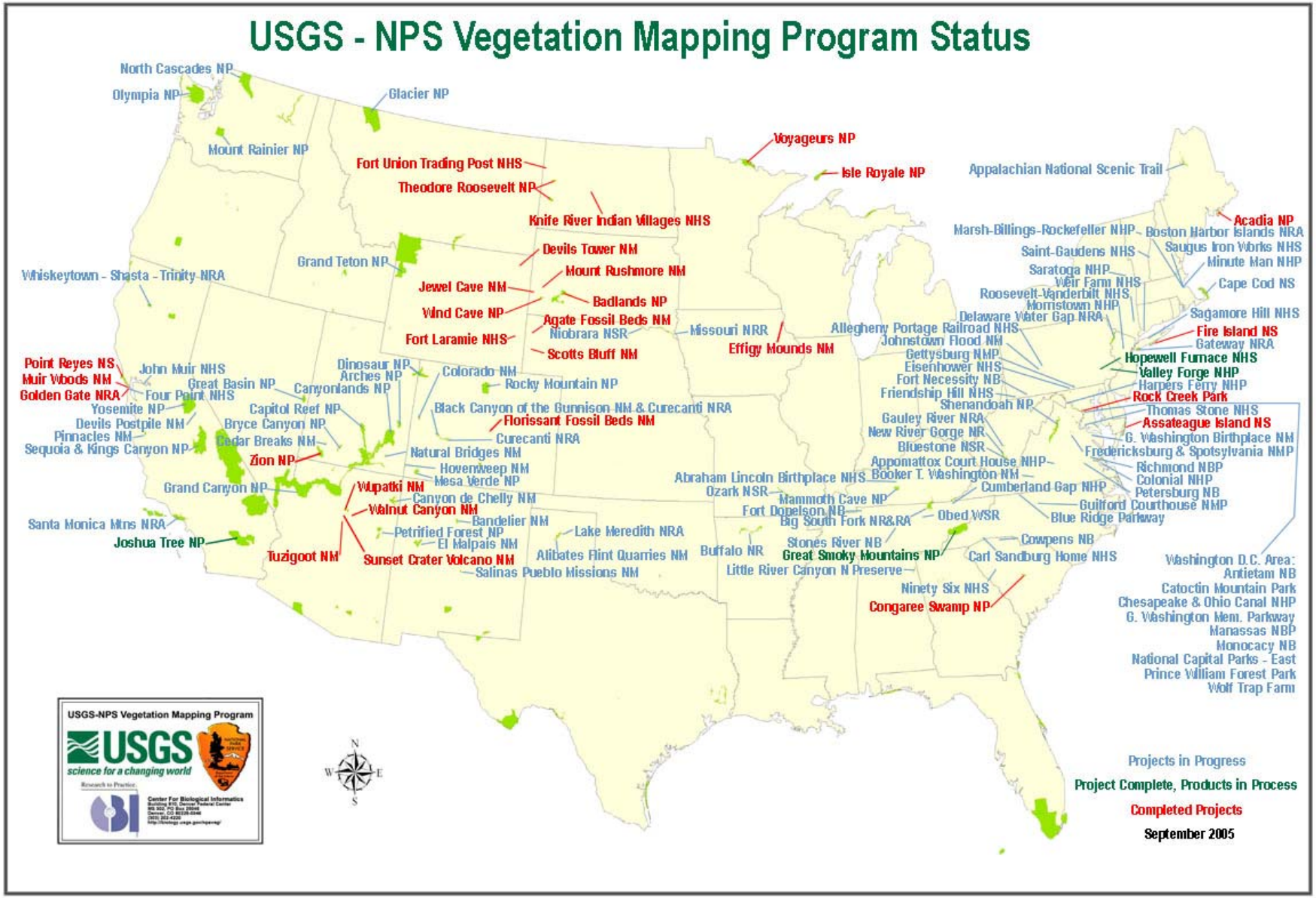
- Map vegetation of all National Park units in the US
- Use a standard national vegetation classification system (NVC)
- Provide useful information to park resource managers

  (baseline data for I&M)




Status of USGS-NPS Vegetation Mapping Program
Glacier NP
Voyageurs NP
Isle Royale NP
Fort Union Trading Post NHS
Theodore Roosevelt NP
Knife River Indian Villages NHS
Acadia NP
Cape Cod NS
Devils Tower NM
Grand Teton NP
Whiskeytown-Shasta-Trinity NRA
Mount Rushmore NM
Jewel Cave NM
Badlands NP
Wind Cave NP
Agate Fossil Beds NM
Fort Laramie NHS
Scotts Bluff NM
Effigy Mounds NM
Delaware Water GAP NRA
Sagamore Hills NHS
Fire Island NS
Morristown NHP
Gateway NRA
Point Reyes NS
Rocky Mountain NP
Indiana Dunes NL
Thomas Stone NHS
Valley Forge NHP
Yosemite NP
Black Canyon NP-Curecanti NRA
Shenandoah NP
Rock Creek Park
Capitol Reef NP
Florissant Fossil Beds NM
Fredericksburg & Spotsylvania NMP
Assateague Island NS
Sequoia & Kings Canyon NP
Zion NP
G. Washington Birthplace NM
Appomattox Court House NHP
Colonial NHP
Grand Canyon NP
Wupatki NM
Booker T. Washington NM
Richmond NBP
Ozark NSR
Santa Monica Mtns NRA
Sunset Crater Volcano NM
Petersburg NB
Great Smoky Mountains NP
Bandelier NM
Buffalo NR
Joshua Tree NP
Walnut Canyon NM
Congaree Swamp NP
Tuzigoot NM
FY 2001 Park Starts
Parks in Progress
Completed Parks
June 2001
USGS
science for a changing world
Big Cypress N Pres
Everglades NP

2001


USGS - NPS Vegetation Mapping Program Status
North Cascades NP
Olympia NP
Glacier NP
Mount Rainier NP
Voyageurs NP
Isle Royale NP
Fort Union Trading Post NHS
Theodore Roosevelt NP
Knife River Indian Villages NHS
Devils Tower NM
Grand Teton NP
Mount Rushmore NM
Jewel Cave NM
Badlands NP
Wind Cave NP
Agate Fossil Beds NM
Niobrara NSR
Missouri NRR
Effigy Mounds NM
Fort Laramie NHS
Scotts Bluff NM
Whiskeytown - Shasta - Trinity NRA
Point Reyes NS
Muir Woods NM
Golden Gate NRA
John Muir NHS
Great Basin NP
Four Point NHS
Yosemite NP
Devils Postpile NM
Pinnacles NM
Sequoia & Kings Canyon NP
Dinosaur NP
Arches NP
Canyonlands NP
Capitol Reef NP
Bryce Canyon NP
Cedar Breaks NM
Zion NP
Colorado NM
Rocky Mountain NP
Black Canyon of the Gunnison NM & Curecanti NRA
Florissant Fossil Beds NM
Curecanti NRA
Natural Bridges NM
Hovenweep NM
Mesa Verde NP
Grand Canyon NP
Wupatki NM
Canyon de Chelly NM
Walnut Canyon NM
Bandelier NM
Petrified Forest NP
El Malpais NM
Santa Monica Mtns NRA
Joshua Tree NP
Tuzigoot NM
Sunset Crater Volcano NM
Salinas Pueblo Missions NM
Lake Meredith NRA
Alibates Flint Quarries NM
Buffalo NR
Little River Canyon N Preserve
Stones River NB
Great Smoky Mountains NP
Ninety Six NHS
Congaree Swamp NP
Abraham Lincoln Birthplace NHS
Ozark NSR
Mammoth Cave NP
Fort Donelson NB
Big South Fork NR&RA
Obed WSR
Cumberland Gap NHP
Appomattox Court House NHP
Booker T. Washington NM
Blue Ridge Parkway
Guilford Courthouse NMP
Petersburg NB
Colonial NHP
Richmond NBP
Fredericksburg & Spotsylvania NMP
G. Washington Birthplace NM
Assateague Island NS
Thomas Stone NHS
Rock Creek Park
Harpers Ferry NHP
Valley Forge NHP
Hopewell Furnace NHS
Gateway NRA
Fire Island NS
Sagamore Hill NHS
Cape Cod NS
Minute Man NHP
Saugus Iron Works NHS
Boston Harbor Islands NRA
Acadia NP
Appalachian National Scenic Trail
Marsh-Billings-Rockefeller NHP
Saint-Gaudens NHS
Saratoga NHP
Weir Farm NHS
Roosevelt-Vanderbilt NHS
Morristown NHP
Delaware Water Gap NRA
Allegheny Portage Railroad NHS
Johnstown Flood NM
Gettysburg NMP
Eisenhower NHS
Fort Necessity NB
Friendship Hill NHS
Shenandoah NP
Gauley River NRA
New River Gorge NR
Bluestone NSR
Cowpens NB
Carl Sandburg Home NHS
Washington D.C. Area:
Antietam NB
Catoctin Mountain Park
Chesapeake & Ohio Canal NHP
G. Washington Mem. Parkway
Manassas NBP
Monocacy NB
National Capital Parks - East
Prince William Forest Park
Wolf Trap Farm
USGS-NPS Vegetation Mapping Program
USGS
science for a changing world
Center For Biological Informatics
N
W
E
S
Projects in Progress
Project Complete, Products in Process
Completed Projects
September 2005

2005

Presentation Summary

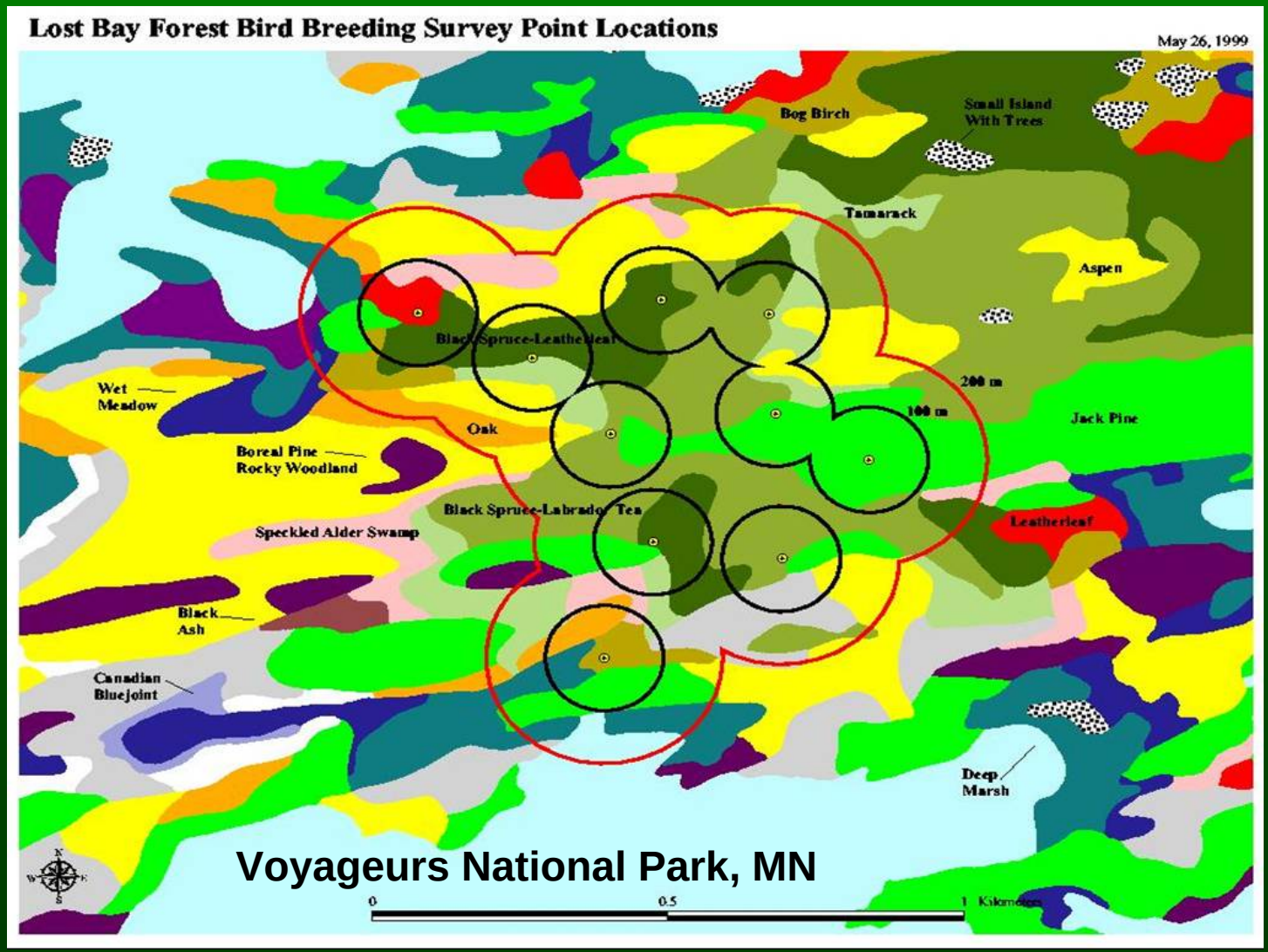
- Why Use Standard Ecological Classifications
- What are Standard Ecological Classifications
- US National Park Service Vegetation Mapping Program
- How Vegetation Maps are Used
- Ecological Classification Methodology
- Mapping Methodology

Why Classify and Map Vegetation?

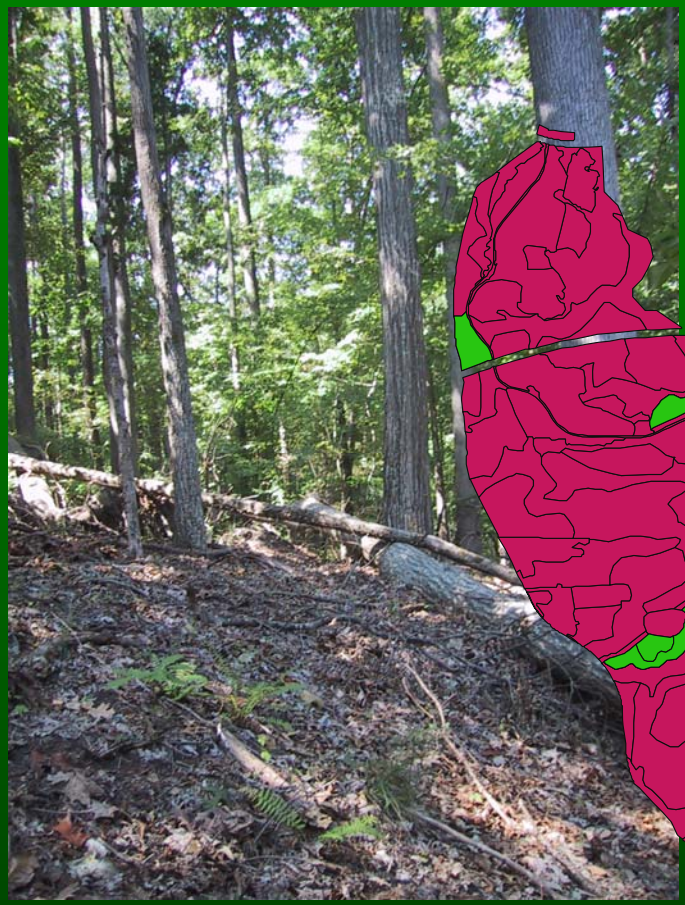
Conservation Uses of Vegetation Classification and Map

- **Stratification for species inventory and monitoring**
- **Predicting Species Distribution (invasives)**
- **Identification of Areas of Conservation Significance**
- **Focusing restoration/mitigation actions**
- "Coarse filter" component of conservation planning
- Active Resource Management (monitor sensitive species habitat, fire)
- Landscape analysis
- Identify Status, Threats, and Trends
- Provide a baseline for assessing change
- Conservation plans, conservation assessments, Biodiversity Significance Layers, DSS, etc.
- Provide understanding of ecological processes at work and opportunities for restoration
- Directing field inventory for communities
- Interpretation and public education
- Habitat Modeling

Predict Bird Habitat And Stratify Sampling



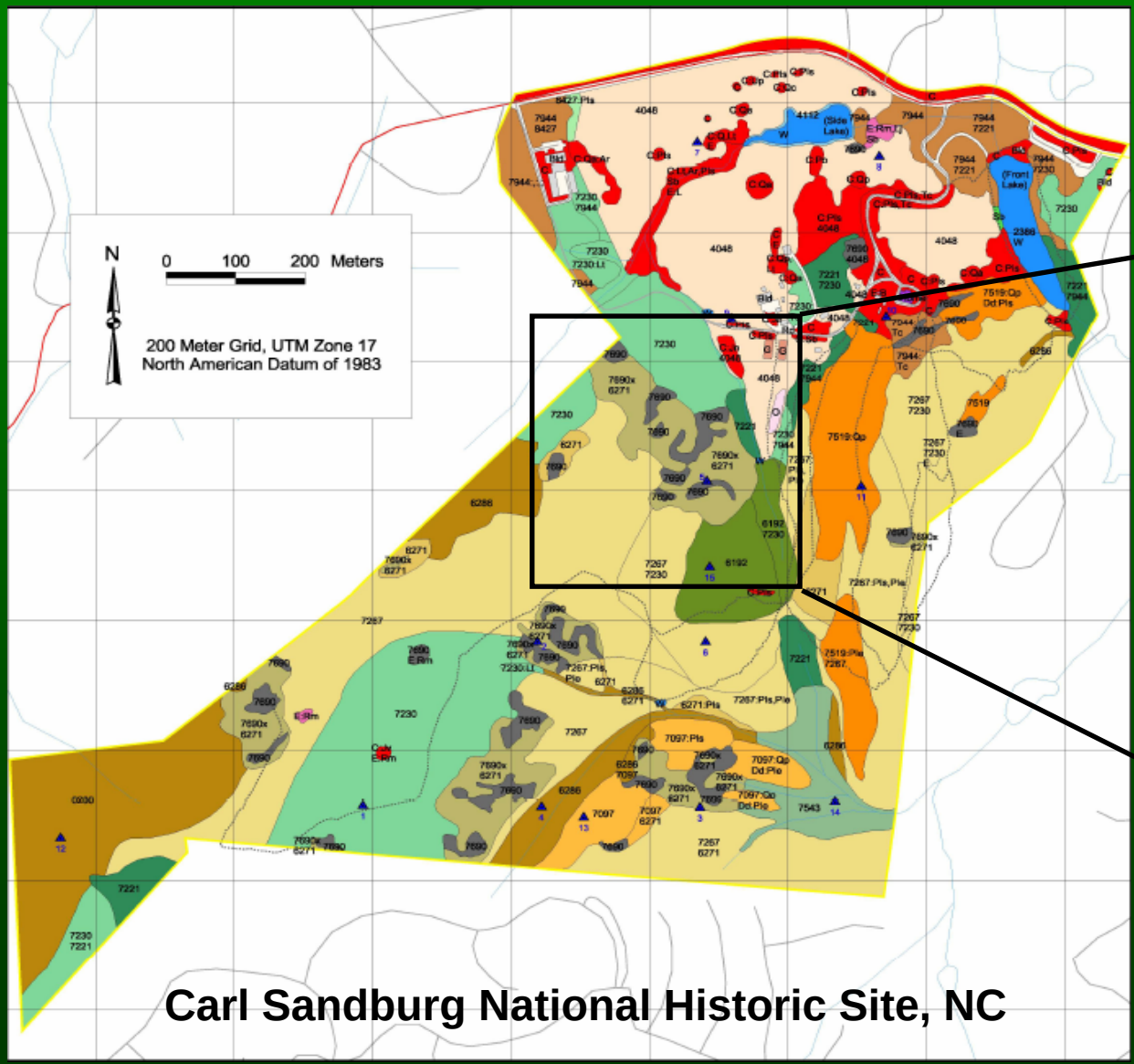
Prioritize Invasive Species Control



Petersburg National Battlefield, VA

DCR
Department of Conservation & Recreation
CONSERVING VIRGINIA'S NATURAL AND RECREATIONAL RESOURCES
Virginia Natural Heritage Program

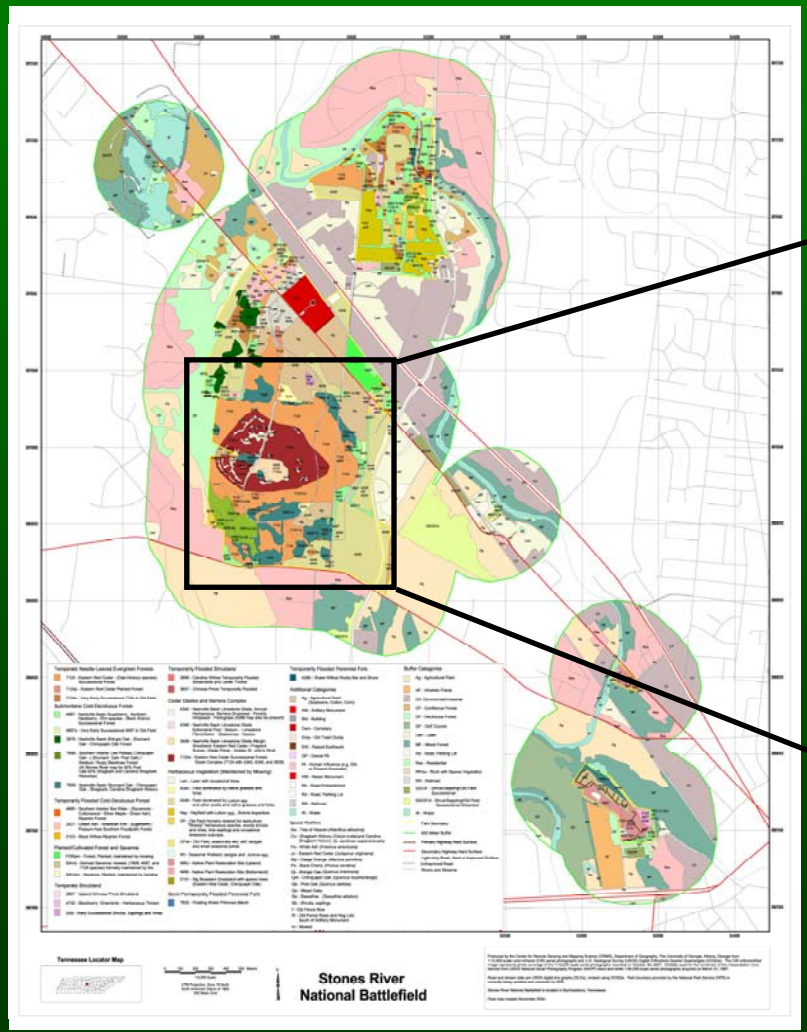
ID Conservation Focus Sites



Carl Sandburg National Historic Site, NC

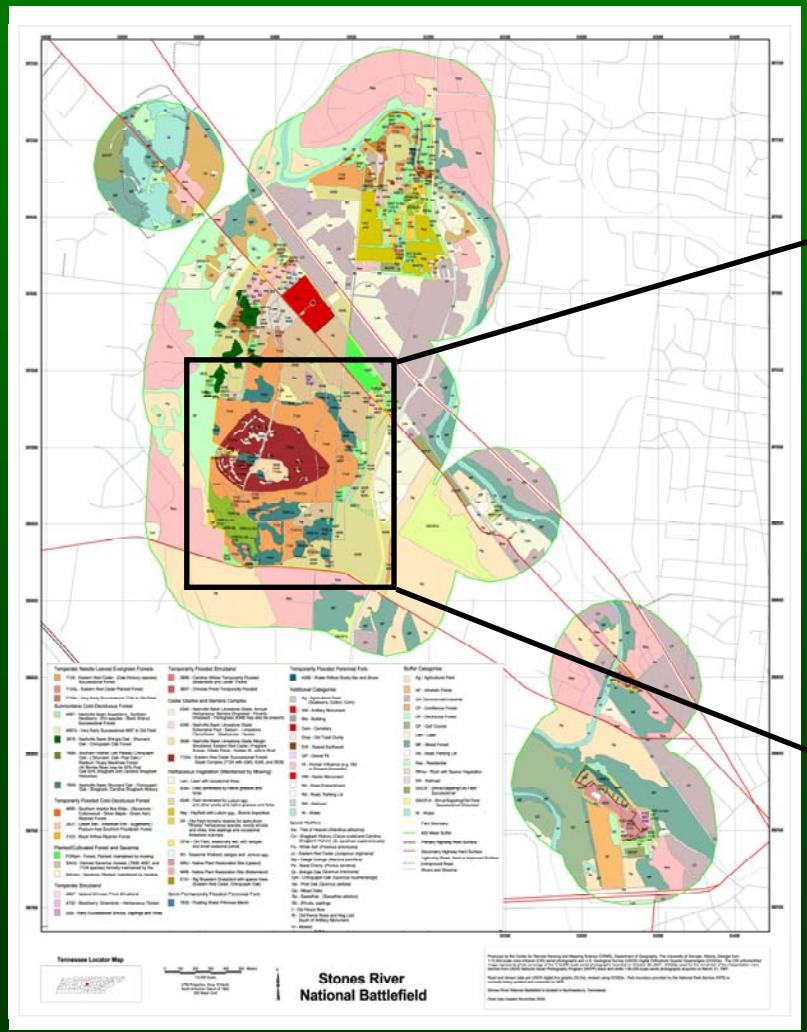
Map courtesy of Univ. of Georgia CRMS

Provide Understanding of Ecological Processes and Restoration Opportunities



Stone's River National Battlefield, TN

Provide Understanding of Ecological Processes and Restoration Opportunities



Stone's River National Battlefield, TN

Presentation Summary

- Why Use Standard Ecological Classifications
- What are Standard Ecological Classifications
- US National Park Service Vegetation Mapping Program
- How Vegetation Maps are Used
- Ecological Classification Methodology
- Mapping Methodology

Timeline of Events

Scoping Mtg

Acquire Imagery

Classification

Design, Field Sampling, Database, Analysis, Descriptions

Add'tl Inter-action

Mapping

Fieldwork, Map Classification, Mapping – Park Lands for AA, Mapping – Environs)

Accuracy Assessment

Design, Fieldwork, Database, Analysis, Results

Wrap-up/Delivery

GIS Datasets, Project Report, & ALL Remaining VMP Products

Individual Park vs. Regional / Network Efforts

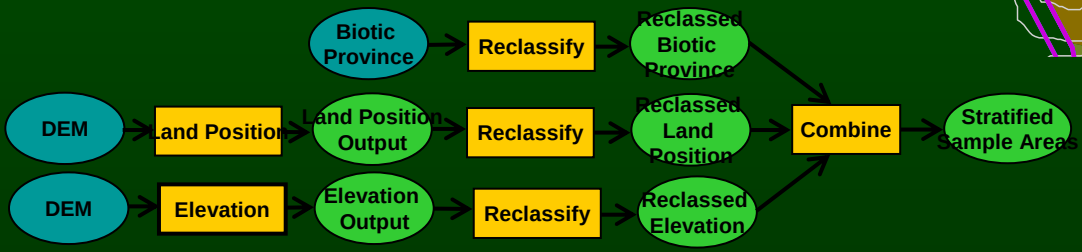
- Regional scale provides opportunities to sample across the range of vegetation types
- Helps to illustrate relationships between vegetation at different parks

Ecological Classification Process

- Identify sampling strategy
- Collect data
- Classify data
- Describe vegetation types
- Provide classification and location data to photointerpreters
- Classification (from analysis of field data) and interpreted photography are mutually refined

Biophysical modeling to stratify sample locations

*Sample extension used to randomly locate points within stratification areas



Blue Ridge Parkway, NC

Vegetation data collected:

- Cover of each plant species in each layer
- Diameter data for trees
- Complete plant species lists
- Plot layout follows guidelines but may be adjusted for local circumstances

Environmental Data Collected:

- Basic abiotic information

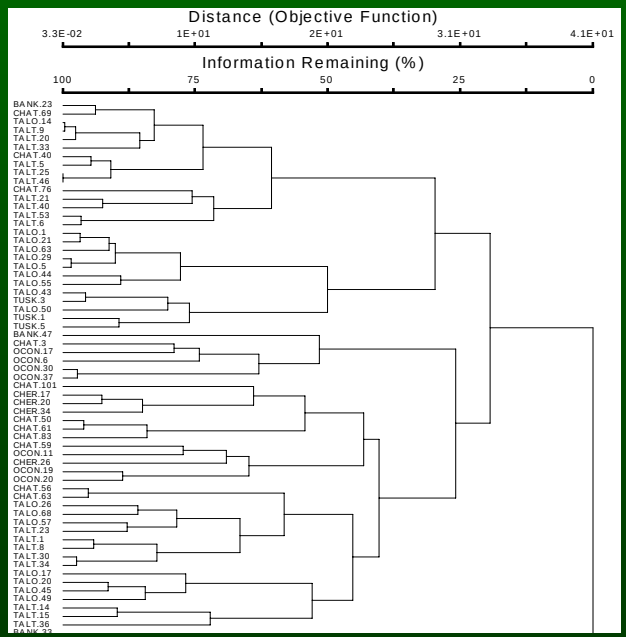
  Slope, aspect, elevation, soil texture, soil drainage, topographic position
- Information on ecological processes

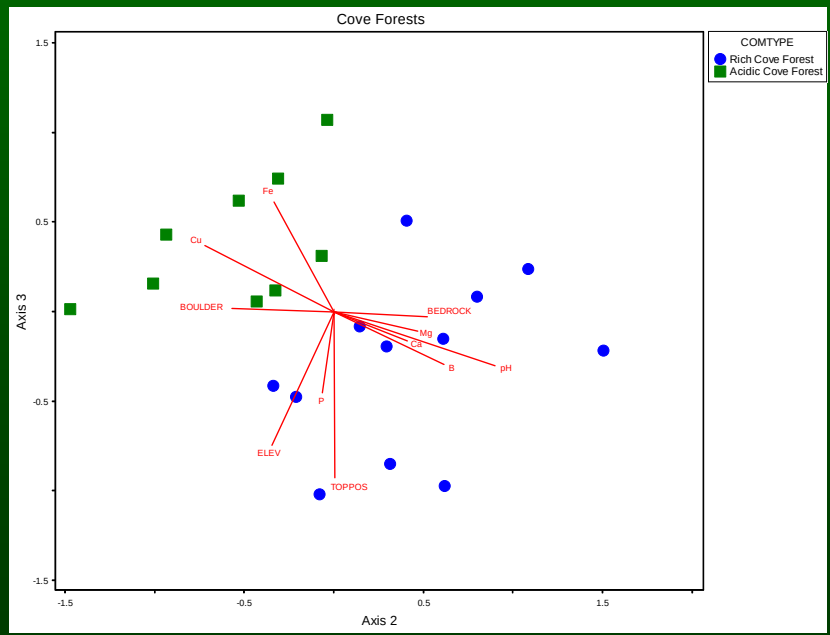
  Fire, animal disturbance, wind throw, hydrologic effects
- General comments

  Plot setting, nearby features that might affect plot (cliff, watercourse, road)

Classification Methods

- Hierarchical, agglomerative cluster analysis
- Ordination Analysis
- Summary Statistics



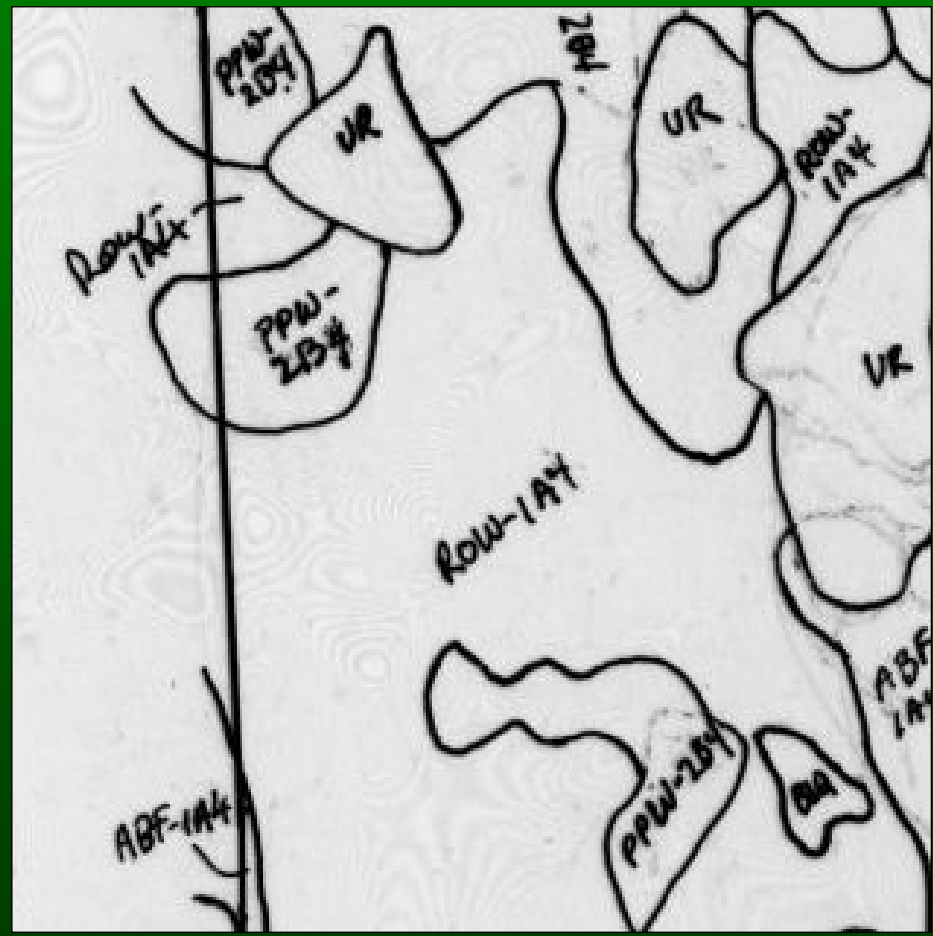


Mapping Process

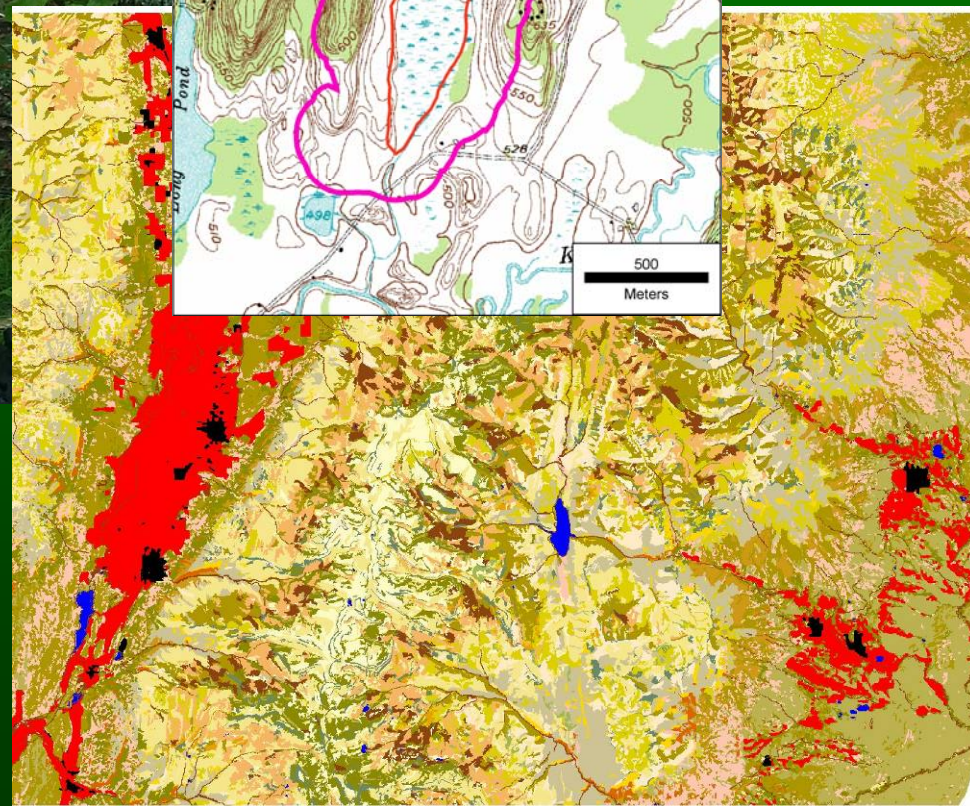
- Acquire and use fine resolution imagery
- Match signatures to known types in the classification
- Delineate polygons
- Refine classification and polygon delineation (iterative process)

Photointerpretation / Automated Methods

Polygon Delineation



Relating the Classification to the Imagery



Linking Field Sample Plots to remotely sensed data

Great Smoky Mountains, NC