# Ecological Site Descriptions – ESDs : NRCS' Site-based Approach to Land Classification and Evaluation

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SSSSNE 20

# Overview

- Definition of Ecological Sites, ES
- Content of Ecological Site Descriptions, ESD
- Rationale for doing ESDs
- Ecological characterization of soils-vegetation
- State-and-Transition Models, STM
- Projects:
  - Northern New England Refuges
  - White Mountains National Forest

# The goal:

Create a *framework* that allows us to *identify*, *map, and describe land* with *similar* physical and biological characteristics (Ecological Sites) at scales suitable for use in natural resource *planning and management*.

# NRCS definition of "Ecological Site"

"An ecological site is a *distinctive kind of land with specific soil* and physical characteristics that differs from other kinds of land in its ability to produce *distinctive kinds and amounts of vegetation*, and in its ability to *respond similarly* to management actions and natural disturbances. [*my emphasis*]

- Shift from strictly *Agricultural* focus to extensive *Ecological* focus
- *(Sites) Soils emphasis* = extension of the Soil Survey
- *i.e.,*= the local *intersection* between soil type (component) & vegetation type… indicative of living & site conditions (natural/humans, *e.g.,* climate, natural disturbances, mgmt).

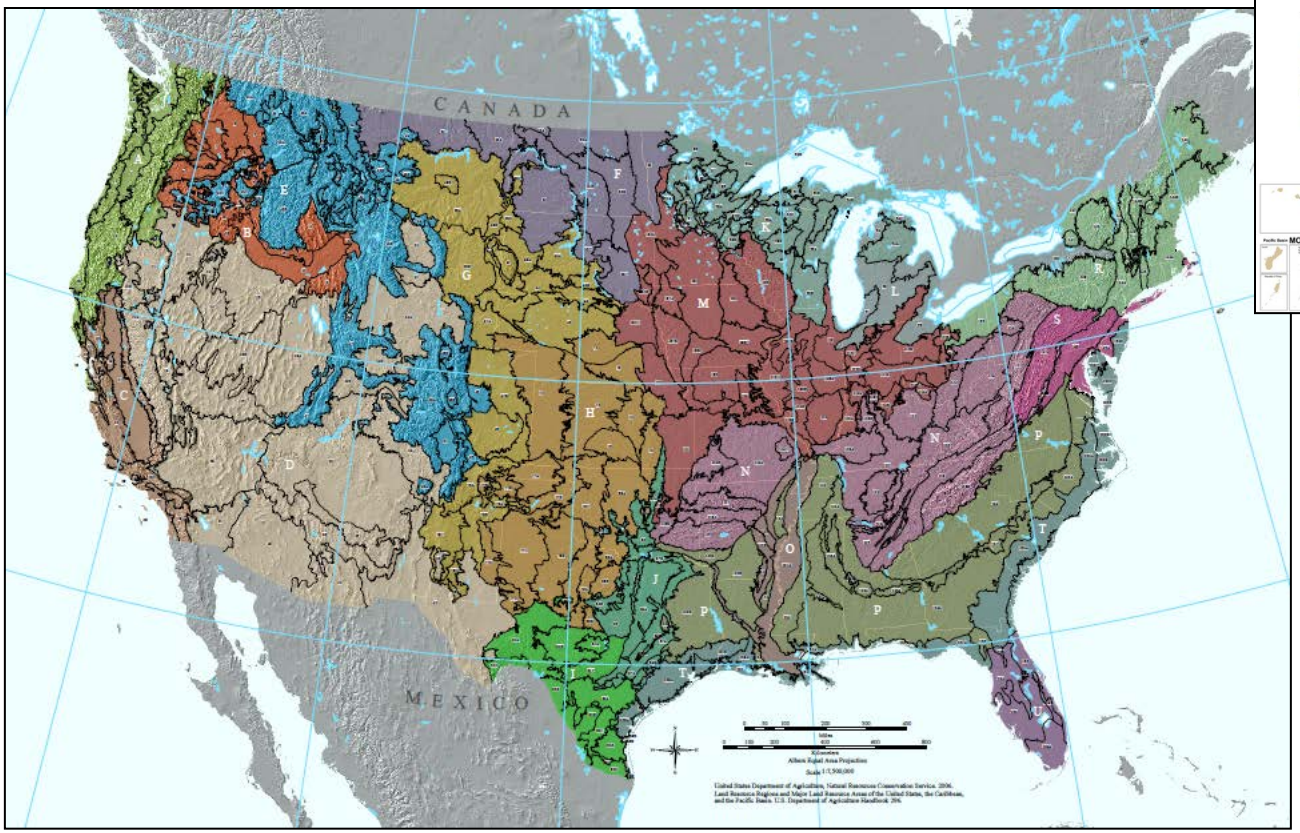
# Ecological Site Descriptions, ESDs

- ESD *Inventory*- a document to organize and store all there is to know about a particular site's ecology, (that characterizes it, yet makes it distinctive from other sites)
- ESDs *Interpretations* - provide for a catalog of interpretations about ecological management and ecosystem services

# **Why do ESDs? –** driving forces…

- Changes in our land management perspectives – acknowledge ecological landscape complexity
- Increases in land management expectations – tend toward multi-use demands
- Expectations for consistent & relevant management – must be adaptive
- Advances in Technology – computing power, geo-spatial tools, etc.
- Available data sets – extensive, comprehensive NRCS soils information & vegetation classifications

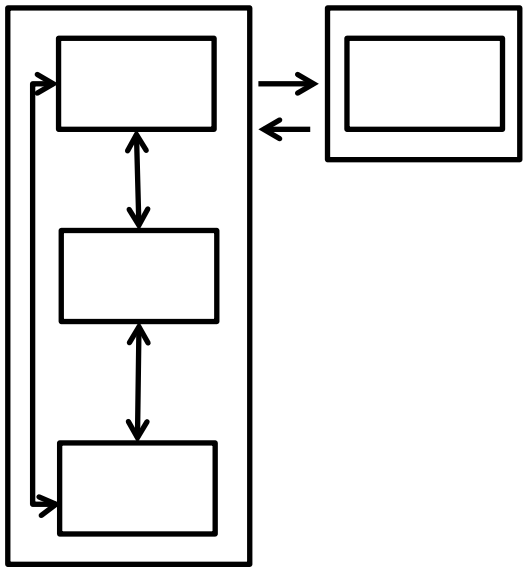
# ESDs "NEW" to the eastern US
# LRR (Land Resource Regions) &
# MLRAs Major Land Resource Regions




# Mechanics:
# ESDs Characterize Ecological Sites


Combining two approaches:

1. ELC – hierarchical, Ecological Land Classification - use of bio-geo-physical attributes (soils, terrain, climate, etc.) for taxonomic description and cartographic differentiation
2. STM – process-based State-and-Transition Model - to describe vegetation (& soil) dynamics in response to management and natural processes.



# 1. ESD Inventory is the fundamental geographic land unit - integrating landform, soil components, and all associated vegetation-types

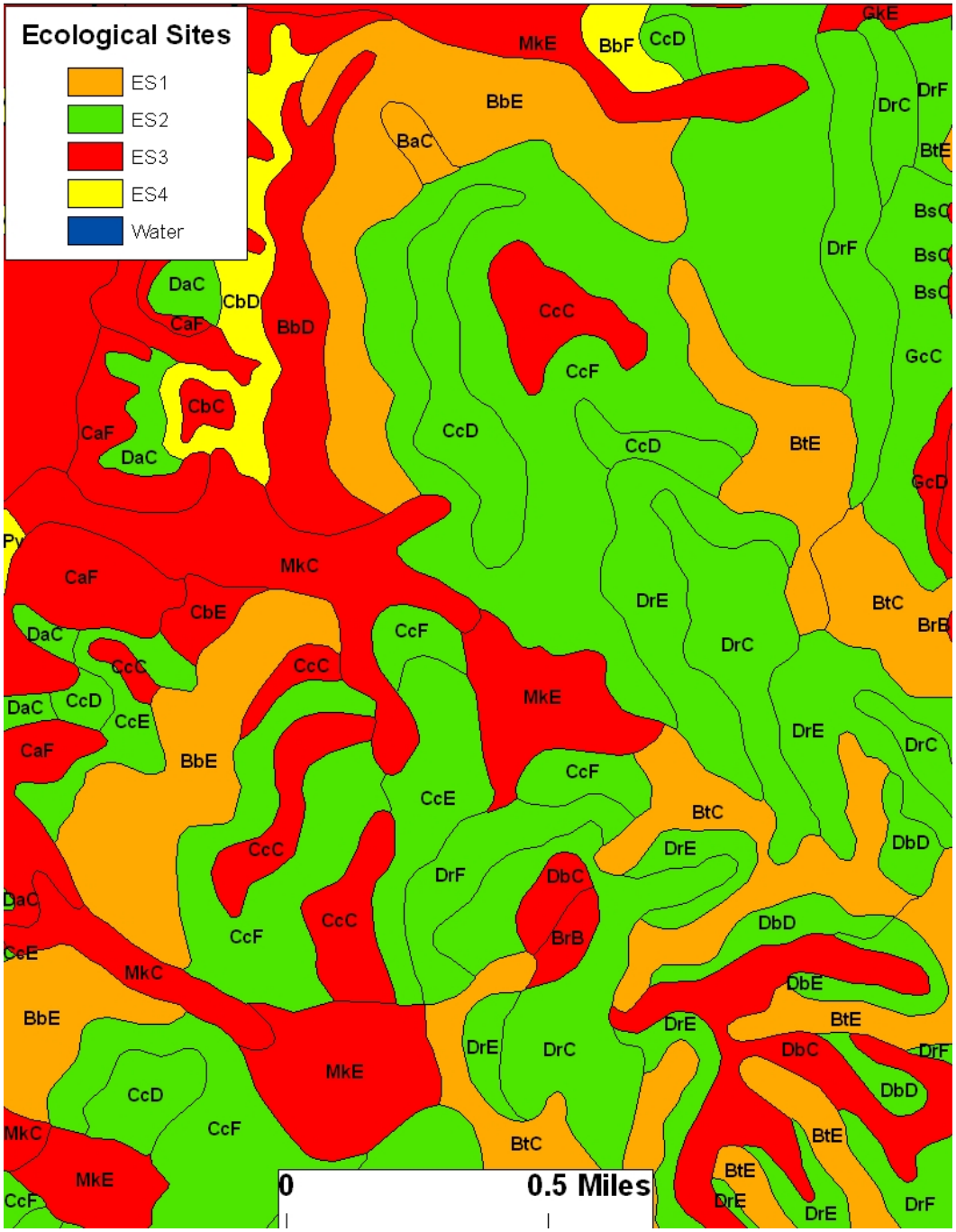
| *Hierarchical Planning and Analysis Levels* | *FS National Hierarchical Framework of Ecological Units* | *General Spatial Extent* | *Principal Differentiating Criteria* | | *NRCS Soil Geography Hierarchy* |
|---|---|---|---|---|---|
| Ecoregion | Domain (1:30,000,000)<br>Division (1:7,500,000)<br>Province (1:5,000,000) | Subcontinental 1,000,000s sq. mi.<br>Multiple States 100,000s sq. mi.<br>Multiple States 10,000s sq. mi. | Continental and Regional Climate Zones; Subcontinental Geography, Broad Soil and Vegetation Affinities / Formations | | Land Resource Region (LRR)/Common Ecological Region (1:7,500,000) |
| Subregion | Section (1:3,500,000)<br>Subsection (1: 250,000) | Regions 1,000s sq mi.<br>Subregions 10s to 100s sq. mi. | Regional/Subregional Climate data; Physiography; Geomorphology; Phases of Soil Orders, Suborders, or Great Groups<br>Vegetation Complexes / Patterns | | Major Land Resource Area (MLRA) (1:3,500,000)<br>Land Resource Unit (LRU) (1:1,000,000)<br>General Soil Map (1:250,000) |
| Landscape | Landtype Association (1:60,000) | Landscape 1000 to 10,000s ac. | Local (Meso-) Climate; Geomorphic Process, Lithology, Relief<br>Soil Associations; Plant Association Complexes | | NA |
| Land Unit | Landtype (1:24.000)<br>Landtype phase (<1:12,000) | Site 1 to 100s ac.<br>Site <100 acres | Landform (Topographic Position - Slope, Aspect, Inclination); Parent Materials, Soil Series components & properties, Plant Associations<br>Phases & Variants; Disturbances & Land Uses | | Detailed Soil Map (1:24,000)<br>Soil Series Phase / Components (1:12,000) |

At the local scale, An ecological site is correlated with one or more soil components.

An ecological site is expressed spatially by the map units that contain the components with which it is correlated.

So, the scale of an ES is determined by the scale of the soil map.

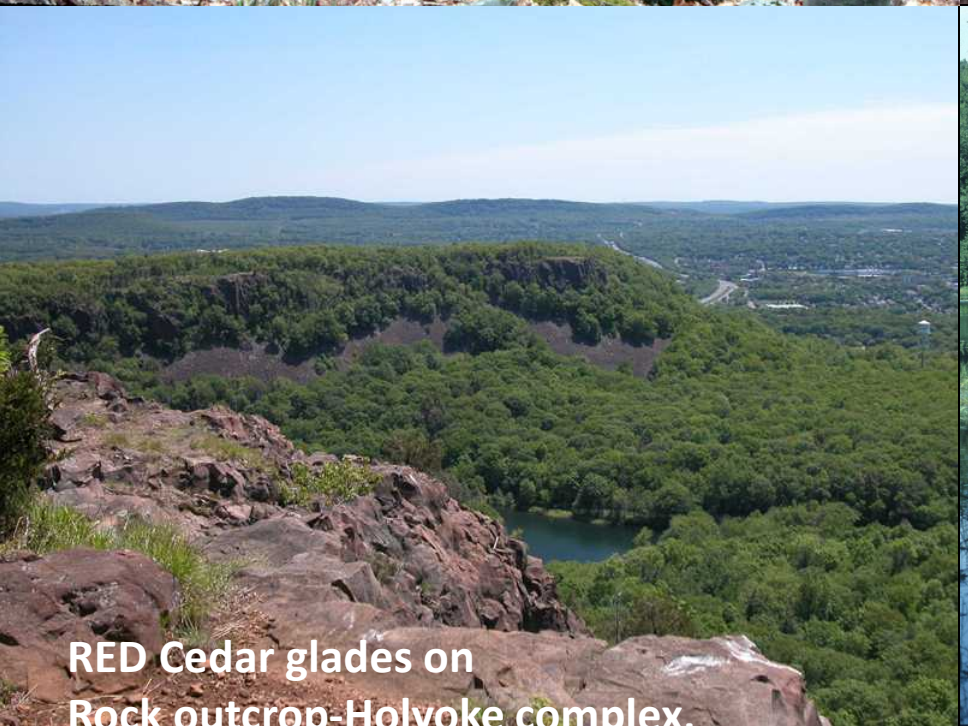
Ecological sites may be mapped as groups of soil map units that contain similar components.



# Soils –vegetation correlation

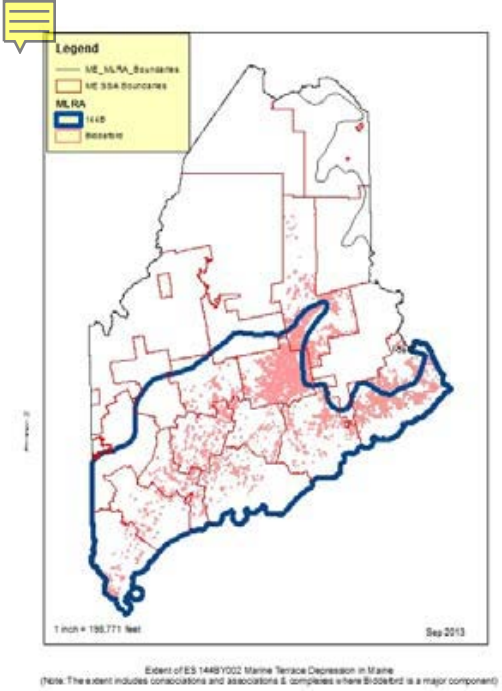
Oak Forests on stoney, WoodBridge

Silver Maples on Hadley floodplain



RED Cedar glades on
Rock outcrop-Holyoke complex.

Emergent vegetation growing in
Subaqueous Soil



Extent of ES 144BY002 Marine Terrace Depression in Maine
(Note: The extent includes consociations and associations & complexes where Biddeford is a major component)

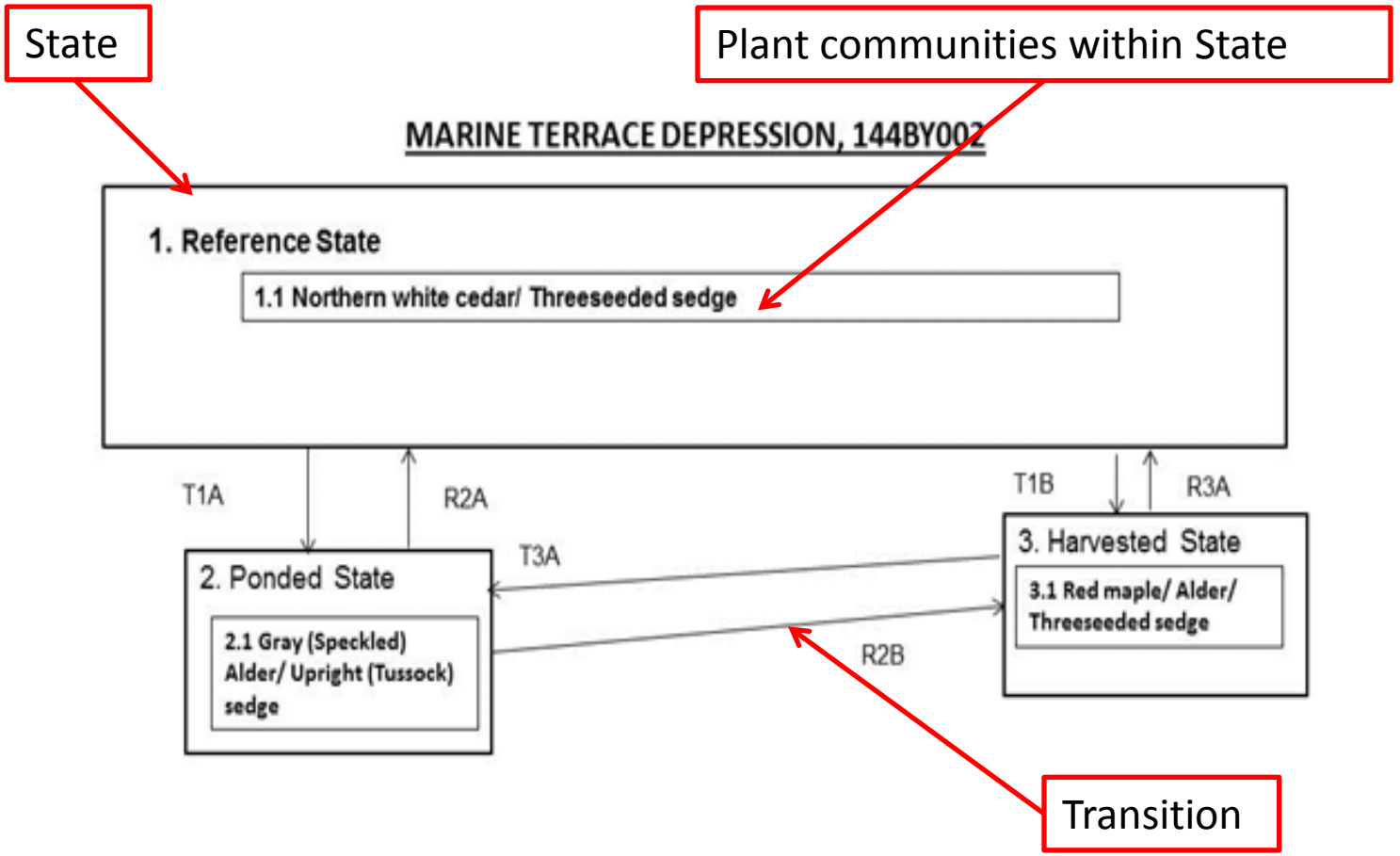
3 of the "STATES" that can exist within Marine Terrace Depression ES


**Reference State**
***Northern white cedar/Threeseeded sedge***

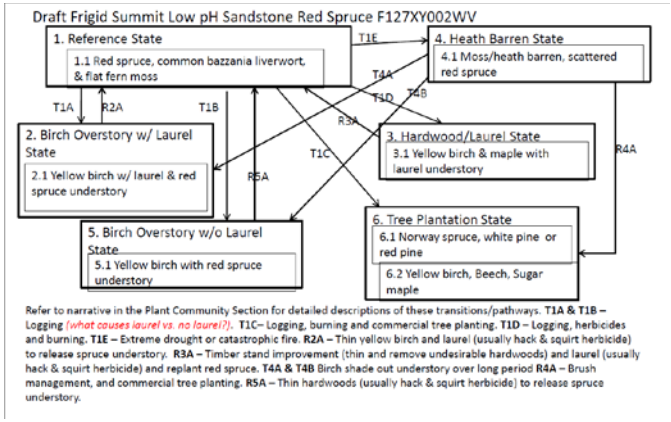

**Ponded State**
***Speckled Alder/Tussock sedge***


**Harvested State**
***Red Maple/ Alder/ Threeseeded sedge***

# Process-based State-and-Transition Model, STM

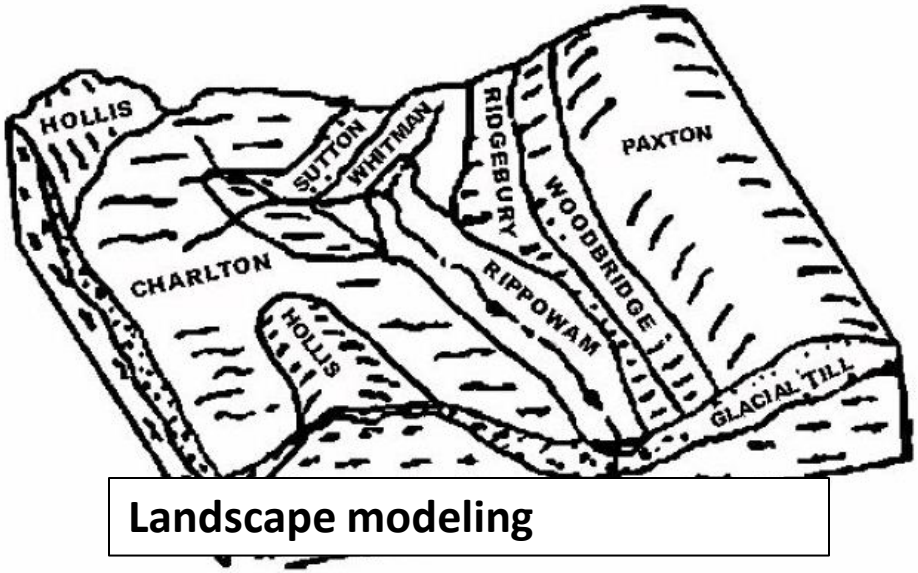


# Transitions are Key




- **Show all <u>transition pathways-</u> contain information about various mechanisms, triggers, and indicators that cross a threshold.**
- **Restoration Pathways – describe <u>restoration techniques</u>**
- **Distinguish changes in vegetation and soils that are easily <u>reversible</u> versus changes subject to thresholds that are not,**

# How are ESDs developed?




Landscape modeling

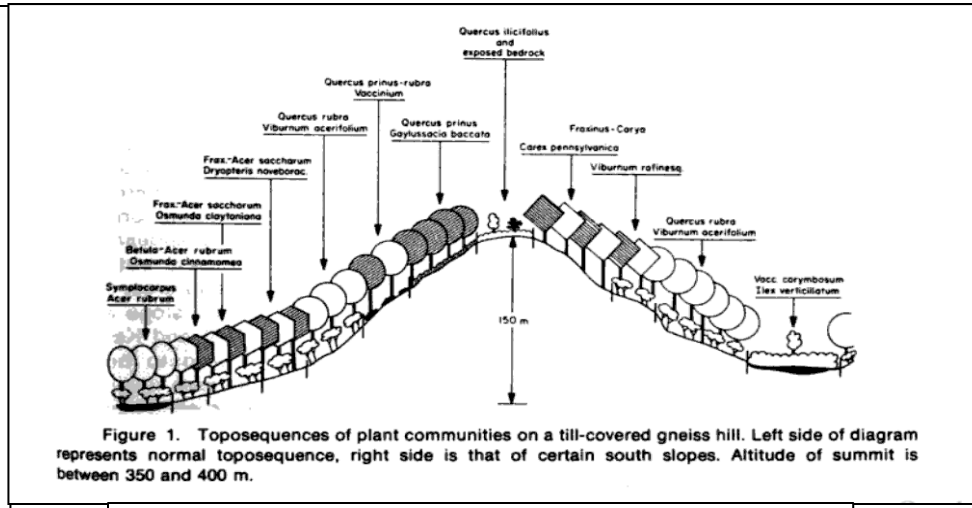



Figure 1. Toposequences of plant communities on a till-covered gneiss hill. Left side of diagram represents normal toposequence, right side is that of certain south slopes. Altitude of summit is between 350 and 400 m.

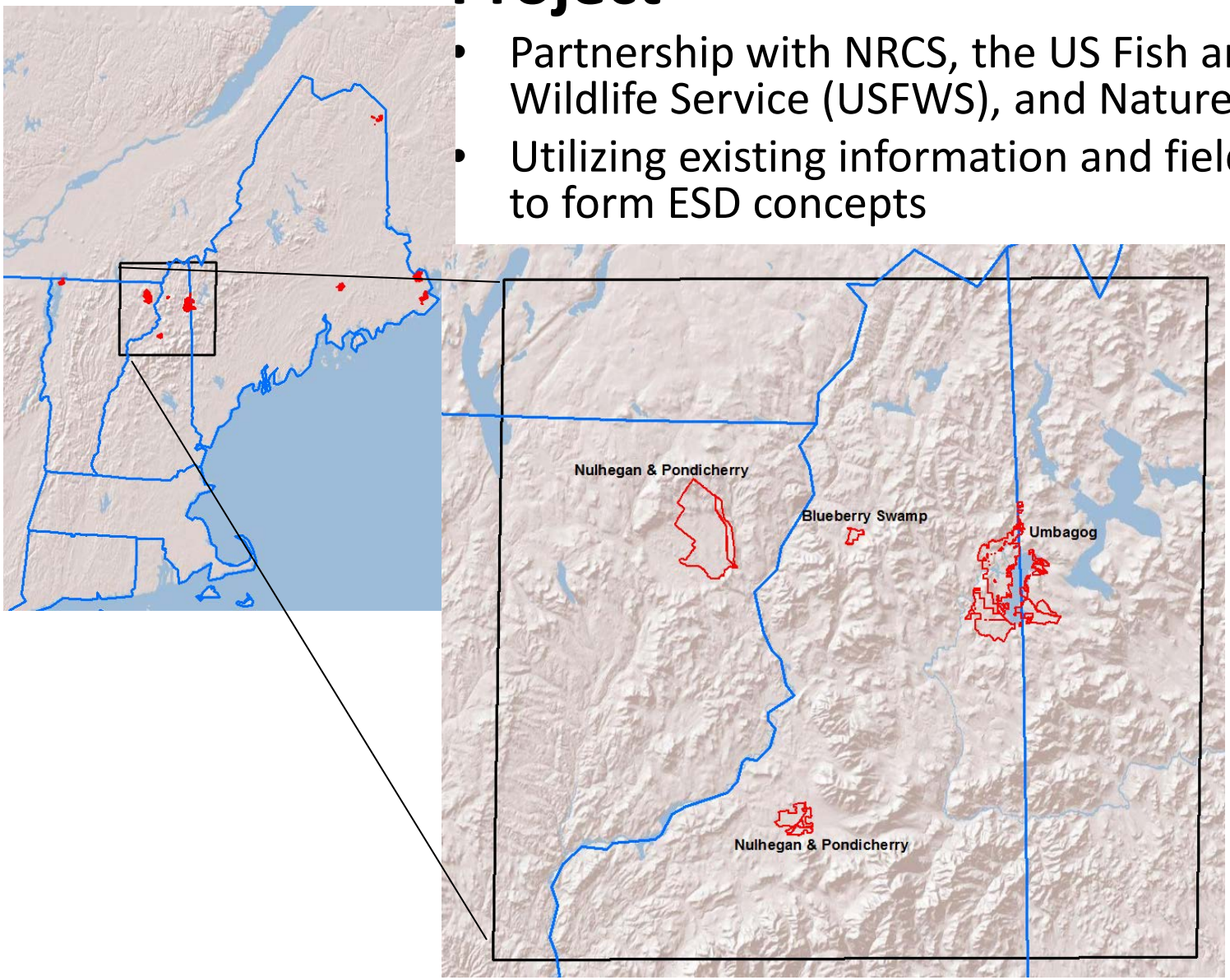
Literature & Databases

Historic reconstruction

Plant / Soil Inventory

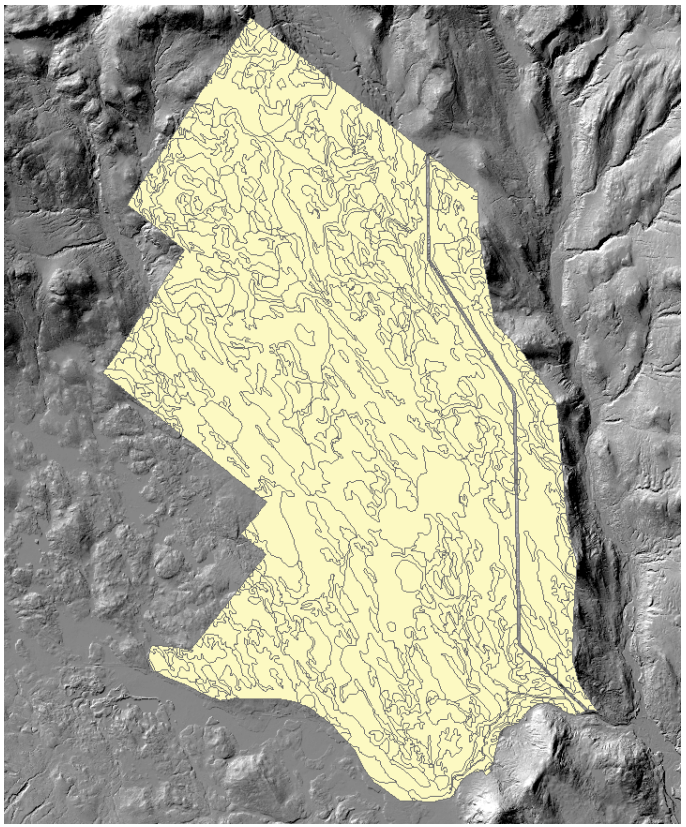
# 1. National Wildlife Refuge Project

- Partnership with NRCS, the US Fish and Wildlife Service (USFWS), and NatureServe
- Utilizing existing information and field checks to form ESD concepts



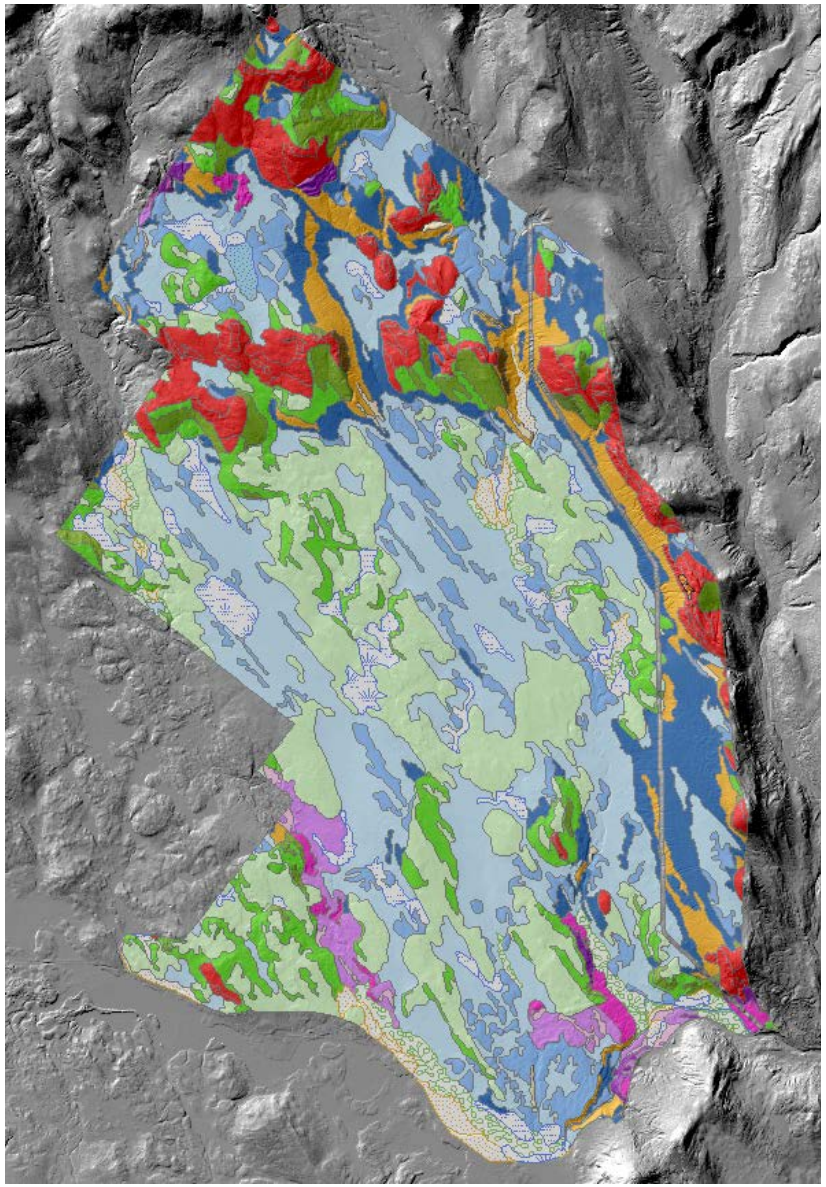
# USFWS Project: Two Approaches

- Form Ecological Sites starting with soil type
  - SSURGO data for entire study area is from 10 different soil surveys



- Start with landform, geology, and/or natural community
  - Ecological Land Unit, ELU, mapping from the Nature Conservancy has decent landform breaks
  - Detailed Natural Community Mapping (Sorenson and Thompson) has been done in the two larger refuges in the study area

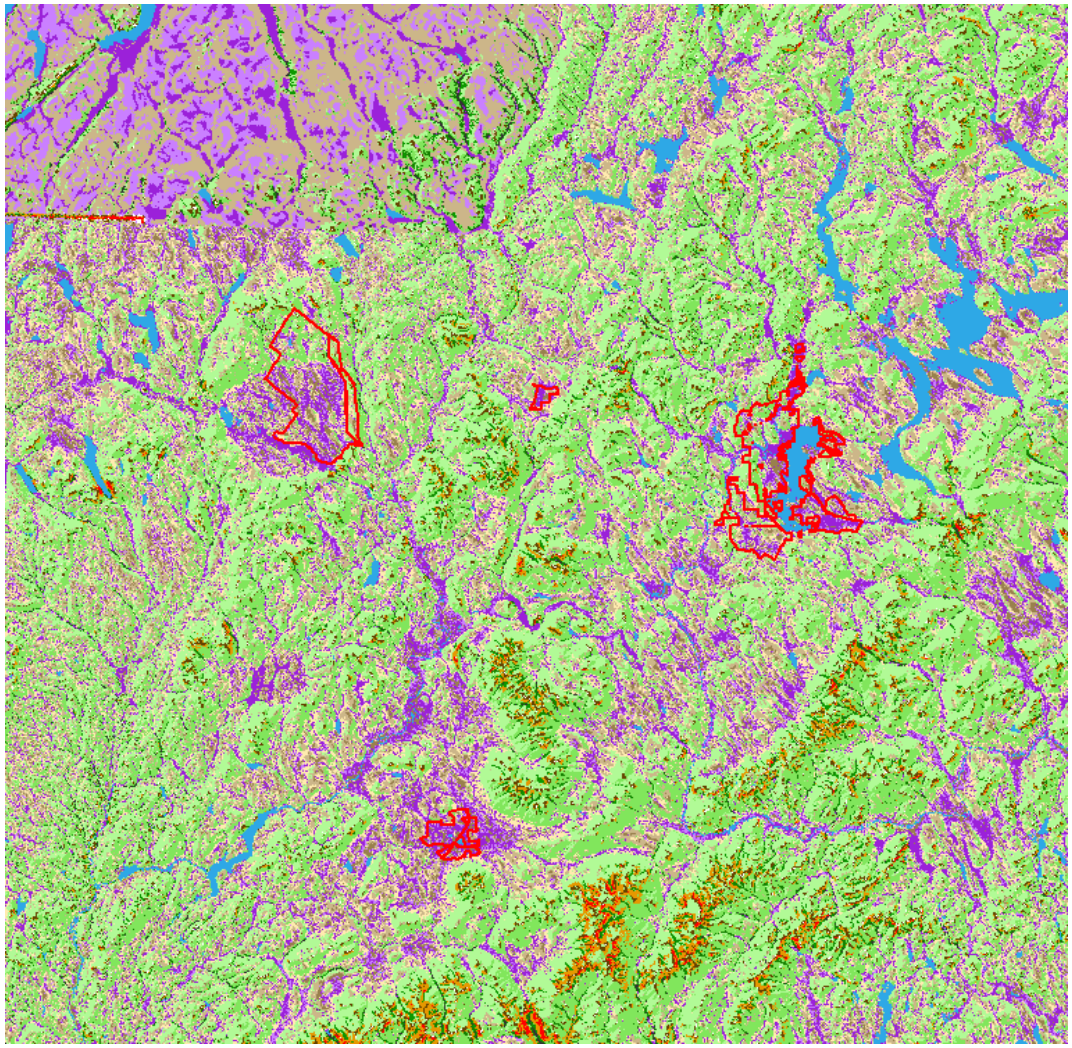
# Potential ecological sites from SSURGO soil types



- PD flat_PD footslope_LTI
- PD flat_PD footslope_SPD footslope_LTI
- PD footslope_SPD footslope_LTI
- SPD footslope_MWD backslope_LTI
- MWD backslope_SPD footslope_LTI
- MWD backslope_LTI
- PD flat_PD footslope_ATI
- MWD backslope_PD footslope_ATI
- WD backslope_MWD backslope_SPD footslope_ATI_LTI
- WD backslope_MWD footslope_ATI
- WD ridge_MWD backslope_PD footslope_UTI_LTI
- WD ridge_SPD backslope_PD footslope_UTI_LTI
- WD ridge_MWD backslope_SPD footslope_UTI_LTI
- WD backslope_MWD backslope_UTI_LTI
- very rocky free face_UTI_ORM
- very rocky summit_shoulder_UTI
- organic
- alluvium
- outwash
- water

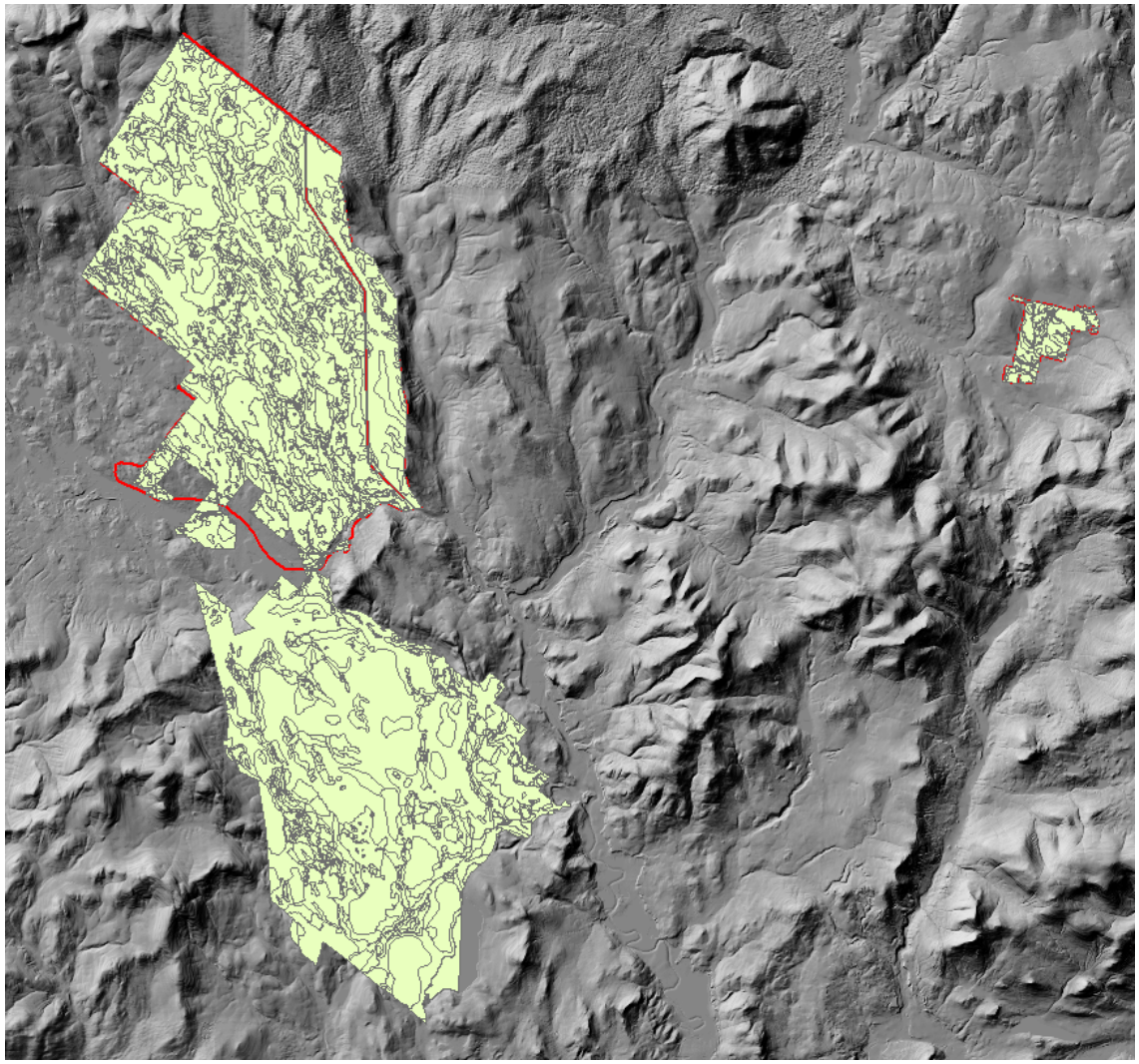
# Ecological Land Units

- The Nature Conservancy
- 30m pixels
- Multiple layers, including elevation zone, geology, landform



- 4: Steep slope
- 5: Cliff
- 11: Flat summit/ridgetop
- 13: Slope crest
- 21: Low hilltop (flat)
- 22: Low hill (gentle slope)
- 23,33: Sideslope cooler aspect
- 24,34: Sideslope warmer aspect
- 30: Dry flats
- 31: Wet flats
- 32: Valley/toe slope: gentle slope
- 41,42: Flat at bottom of steep slope
- 43: Cove or footslope cooler aspect
- 44: Cove or footslope warmer aspect
- 51: River
- 52: Lake/pond/res
- 53, 54: Estuarine/marine

# NVC Natural Communities



Potential natural communities based on physical characteristics of the site

- Sorenson and Thompson natural communities (Montane Yellow Birch – Sugar Maple – Red Spruce Forest; Northern Hardwoood - Hemlock Forest; Northern White Cedar Swamp, etc.)

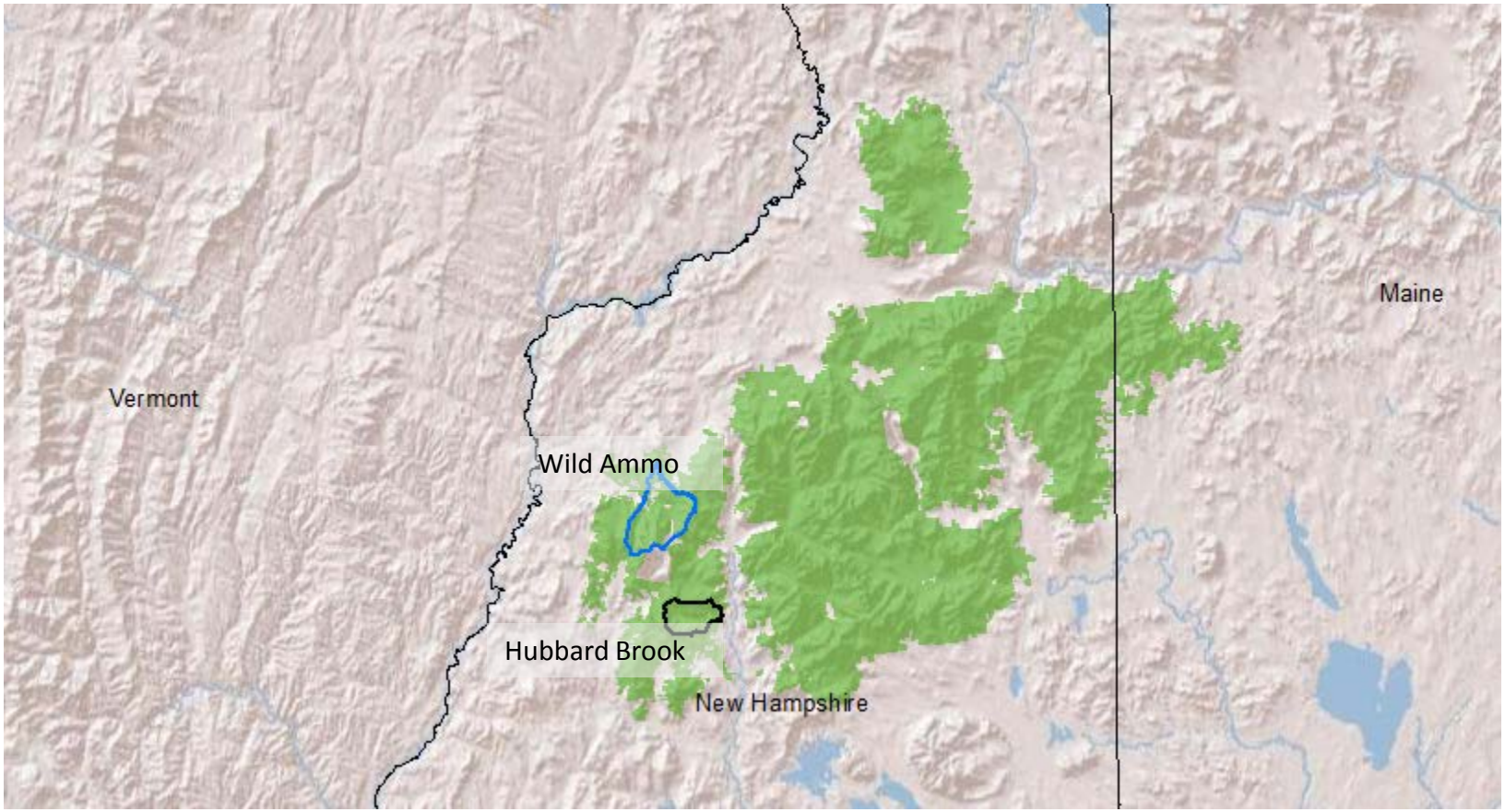
# National Wildlife Refuge Project

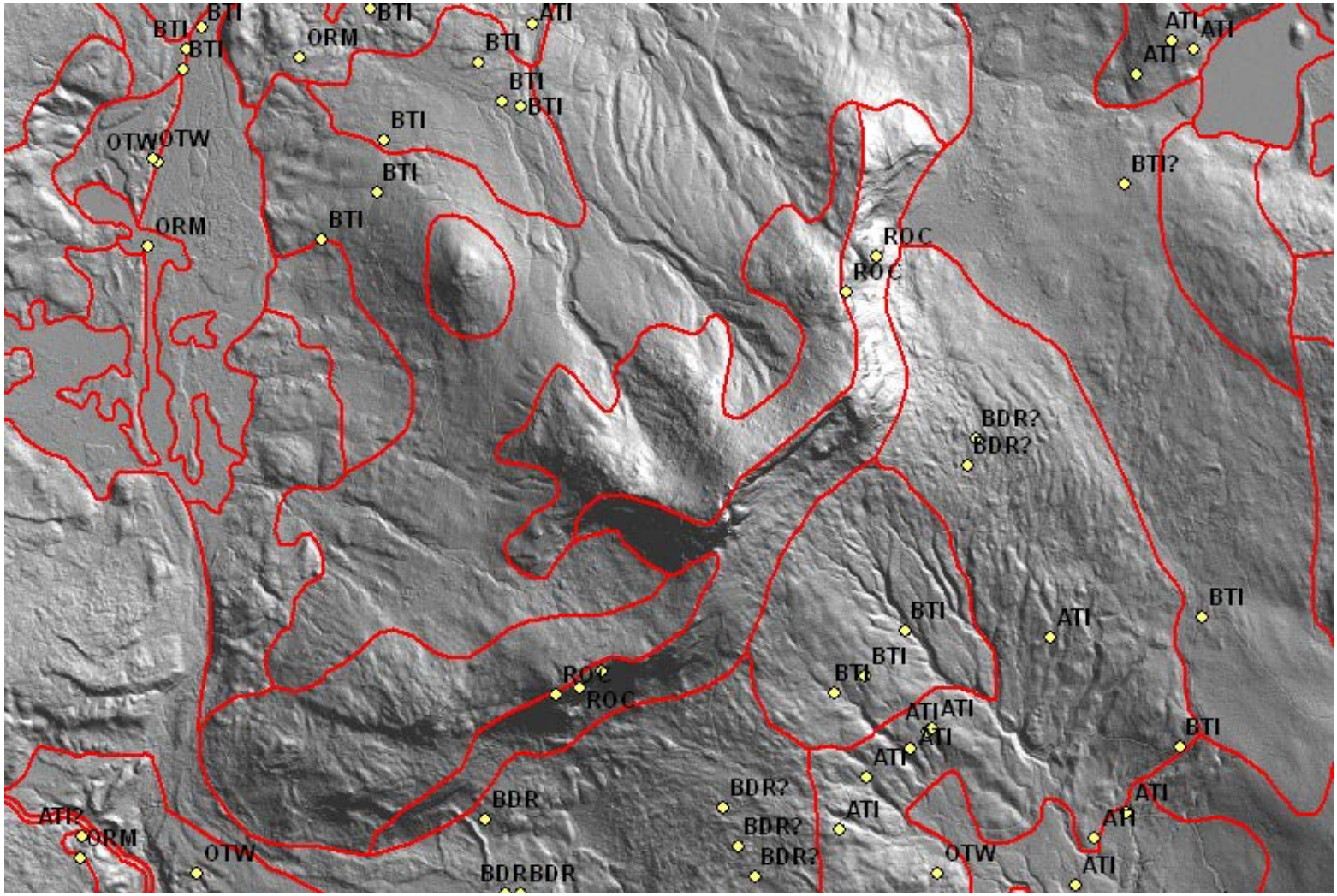
- What's Working?
  - Enthusiastic partnership between NRCS, Fish and Wildlife Service, and NatureServe
  - Extensive local expertise for both soils and veg
  - Support from NRCS to complete ESDs
  - Clear goal of ESDs as the product

- What's unclear?
  - Which approach are we taking to complete ESDs?
  - How do we deal with varying stages of soil mapping and SDJR soil components?

# 2. White Mountain National Forest (WMNF) Project

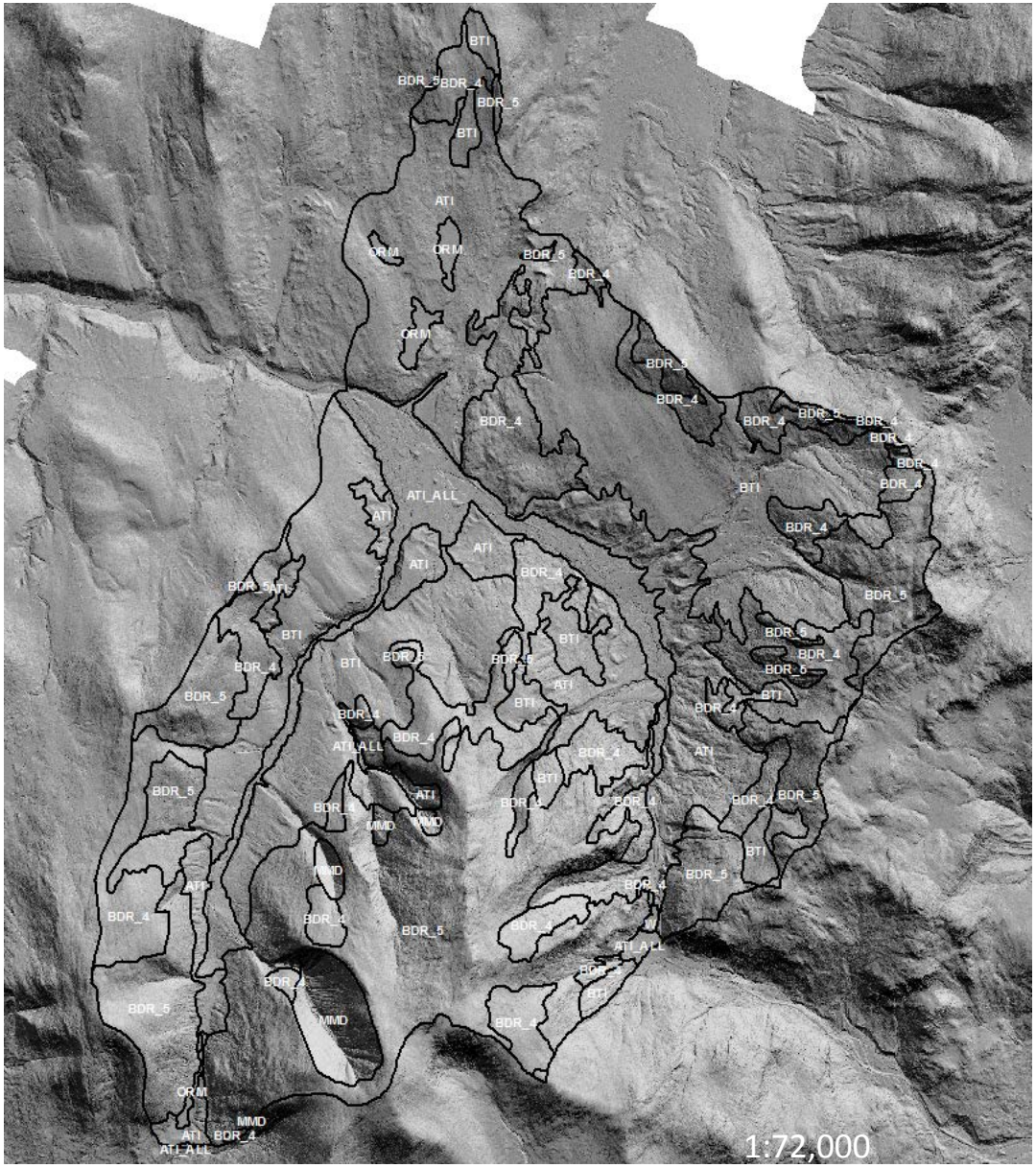
- Partnership with the US Forest Service
- NRCS is using a process of landscape stratification and catena-based raster soil mapping to complete the Soil Survey
- High intensity sampling in the Wild Ammonoosuc Watershed
- Concept validation from existing data in the Hubbard Brook Experimental Forest

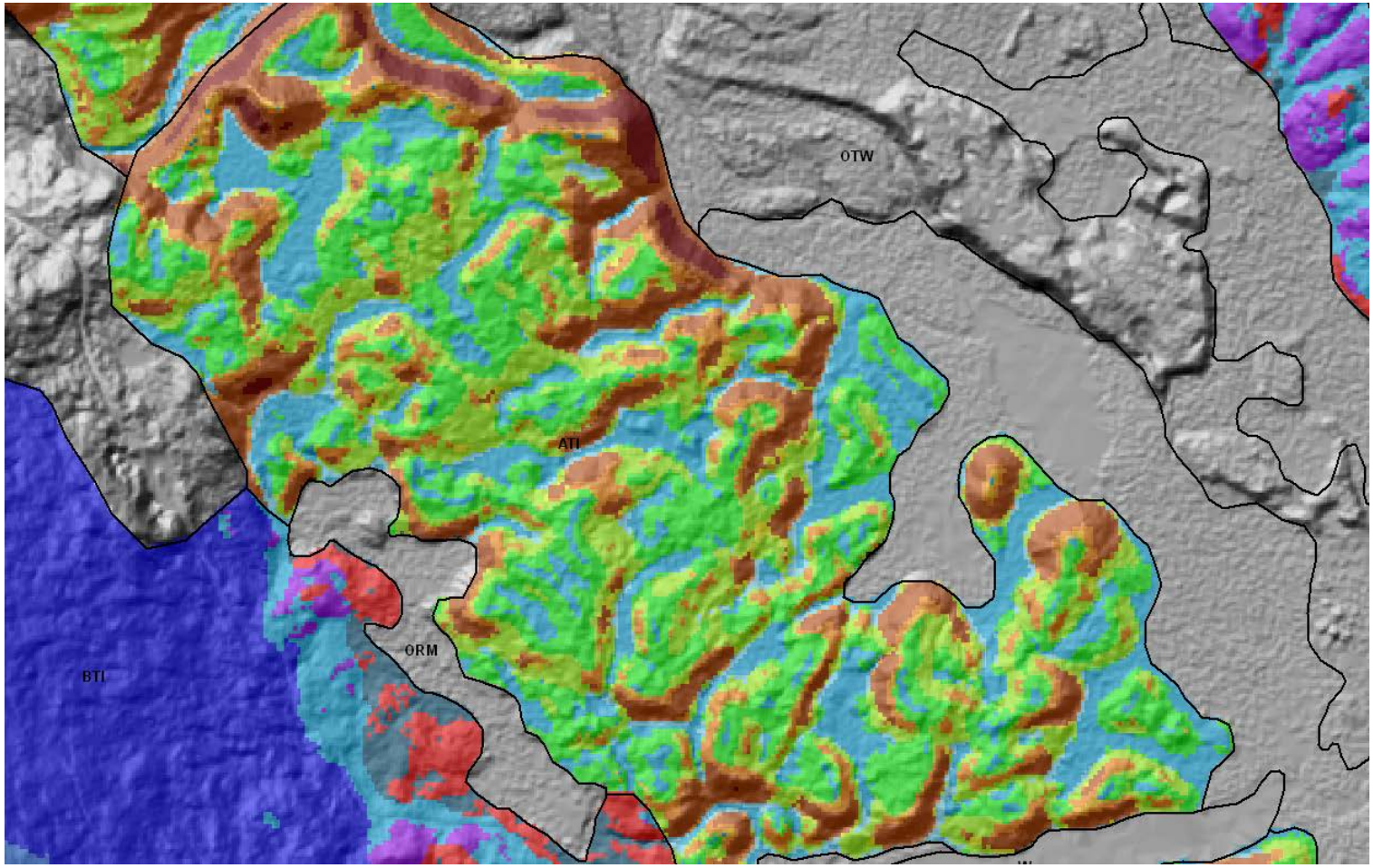





LiDAR signatures, terrain derivatives, CIR (and other imagery), and GPS waypoints from reconnaissance are used for initial landscape stratification.

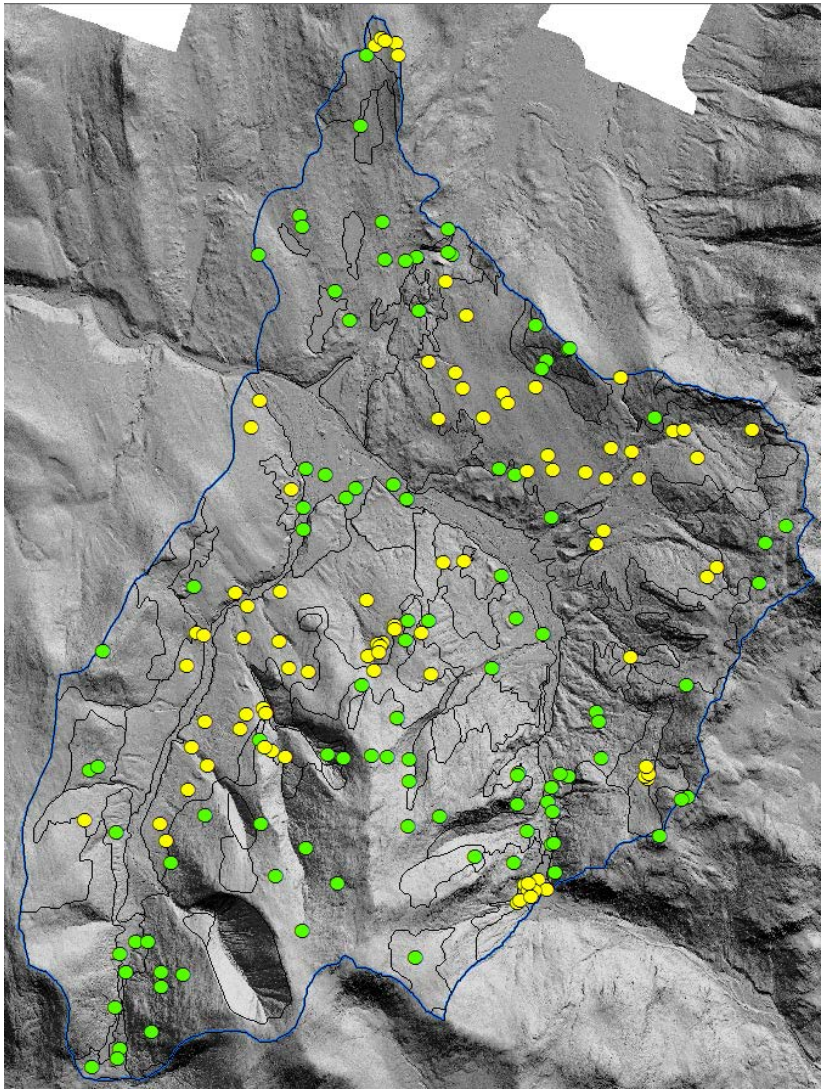
# Parent Material Delineations in the Study Area






The catena models allow us to visualize where different components occur within a “traditional” map unit.

# WMNF Field Sampling



At every site, data collection included:

- Detailed soil description
- Soil samples of O/A, B, and C horizons
- Overstory vegetation
- Understory vegetation

Using the information collected at these 176 sites, multivariate analysis will guide the design of ESDs.

2014 Sampling

2013 Sampling

# WMNF Project

- What's working?
  - Partnership with forest service has allowed for extensive data collection
  - Sharing of different techniques for dealing with that data

- What's unclear?
  - How do TEUI and ESD fit together? Are we doing both?
  - Is this extensive data collection in one area going to be enough to support the entire project?
    - NRCS needs to move forward with the soil survey at a faster pace

# ESD uses…

- Guide conservation planning decisions and refine planning unit to areas that respond similarly
- Inform and guide the establishment and restoration of desired plant communities
- Inform and guide maintenance of existing condition or measures necessary to transition to a desired plant community
- Provide management interps (wildlife, grazing, wood products, hydrology, invasive plant control, target specific species, or other special emphasis).