MONKTON

LANDSCAPE AND NATURAL COMMUNITIES

July 21, 2021

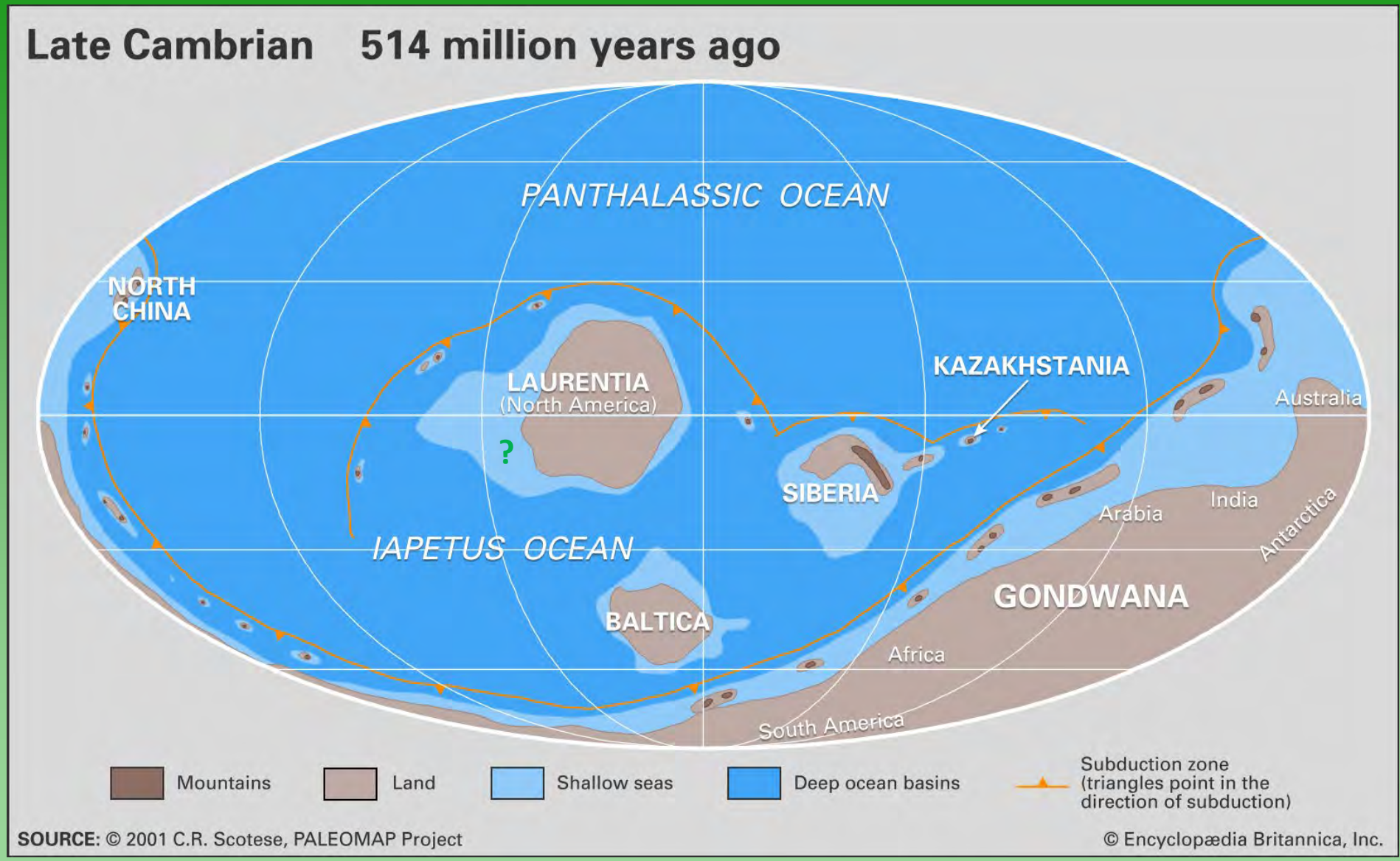
Eric Sorenson
Ecologist

VERMONT

VERMONT FISH & WILDLIFE

The Vermont Fish & Wildlife Department

The mission of the Vermont Fish & Wildlife Department is the conservation of our fish, wildlife, plants and their habitats for the people of Vermont


Late Cambrian 514 million years ago
PANTHALASSIC OCEAN
NORTH CHINA
LAURENTIA
(North America)
?
KAZAKHSTANIA
Australia
SIBERIA
India
Arabia
Antarctica
IAPETUS OCEAN
GONDWANA
BALTICA
Africa
South America
Mountains
Land
Shallow seas
Deep ocean basins
Subduction zone
(triangles point in the
direction of subduction)
SOURCE: © 2001 C.R. Scotese, PALEOMAP Project
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? = Monkton


150°
120°
90°
60°
30°
0°
30°
60°
90°
120°
150°
ARCTIC OCEAN
Arctic Circle
Bering Strait
Baltic Sea
North Sea
EUROPE
English Channel
Black Sea
Caspian Sea
ASIA
Bering Sea
60°
NORTH AMERICA
Mediterranean Sea
Yellow Sea
Persian Gulf
ATLANTIC OCEAN
30°
Tropic of Cancer
Gulf of Mexico
East China Sea
PACIFIC OCEAN
Caribbean Sea
Red Sea
Arabian Sea
Bay of Bengal
South China Sea
AFRICA
PACIFIC OCEAN
0°
Equator
SOUTH AMERICA
ATLANTIC OCEAN
INDIAN OCEAN
Tropic of Capricorn
AUSTRALIA AND OCEANIA
30°
60°
Antarctic Circle
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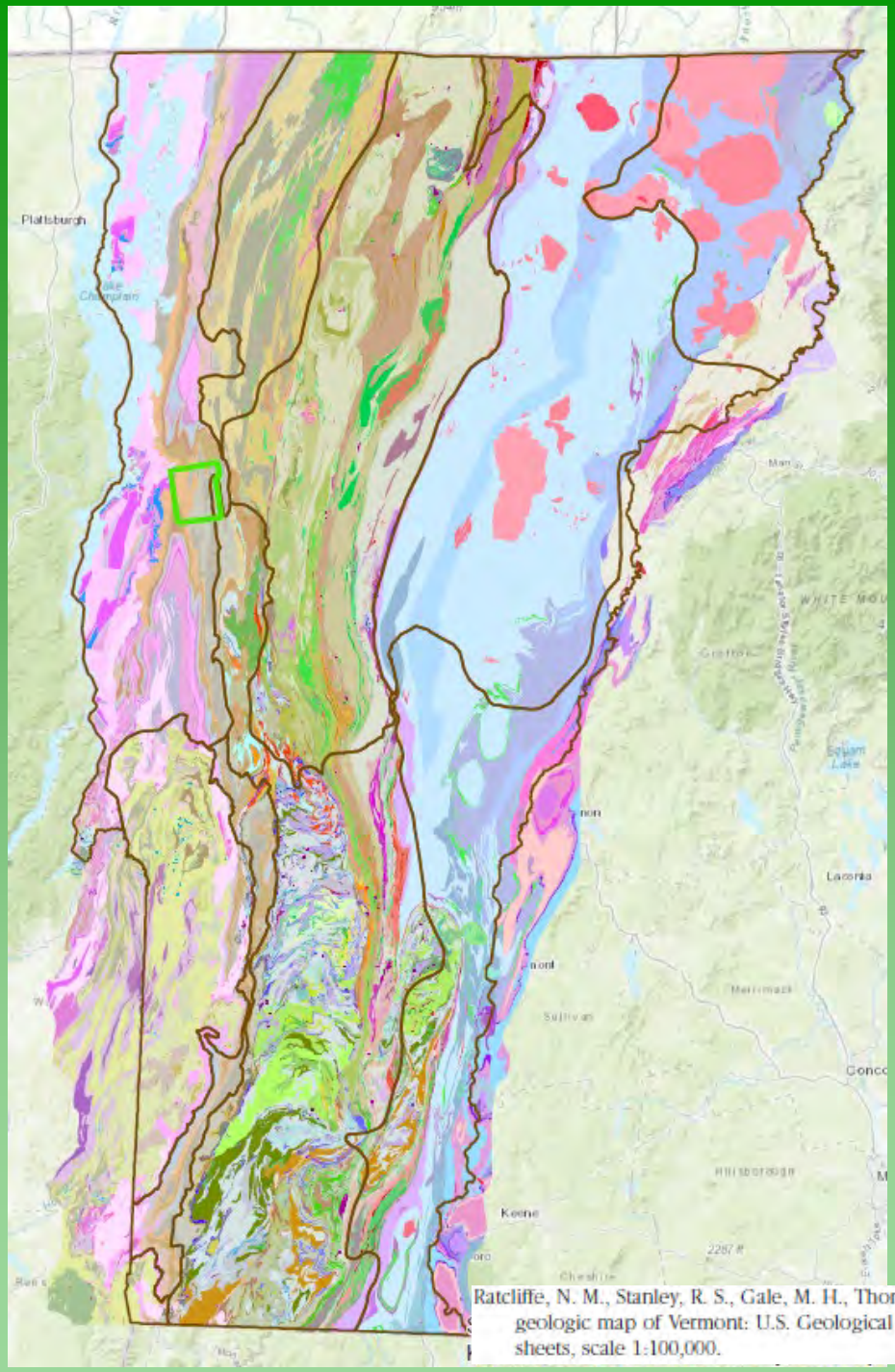
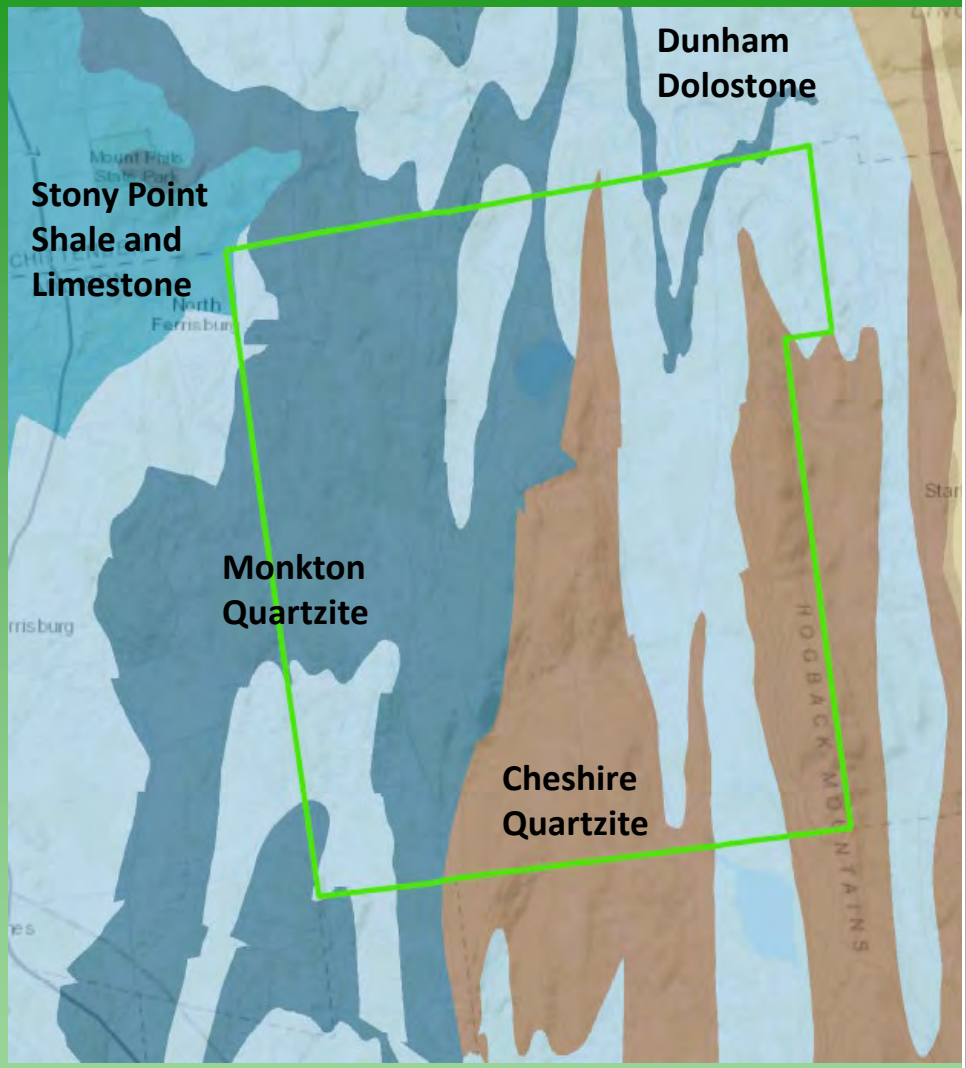
CH
NH
NVP
Burlington
NGM
St. Johnsbury
CV
Montpelier
SVP
White River Junction
VV
Rutland
TM
SGM
Bennington
Brattleboro
TM
BIOPHYSICAL REGIONS
CV: Champlain Valley
CH: Champlain Hills
TM: Taconic Mountains
VV: Vermont Valley
NGM: Northern Green Mountains
SGM: Southern Green Mountains
NVP: Northern Vermont Piedmont
SVP: Southern Vermont Piedmont
NH: Northeastern Highlands



Ratcliffe, N. M., Stanley, R. S., Gale, M. H., Thompson, P. J., and Walsh, G. J. 2011. Bedrock geologic map of Vermont: U.S. Geological Survey Scientific Investigations Map 3184, 3 sheets, scale 1:100,000.



ECOLOGICAL CLASSIFICATION OF BEDROCK

CALCAREOUS SEDIMENTARY AND METASEDIMENTARY ROCKS

Highly calcareous limestones, marbles, and dolomites: These rocks have notable concentrations of carbonate minerals, which weather easily and release calcium and other important plant nutrients. They produce some of Vermont's most diverse natural communities.

Waits River Formation: Phyllite with abundant bands of micaceous marble. This distinctive bedrock formation is largely responsible for the character of Vermont's Piedmont regions.

Moderately calcareous slate, shale and schist: Examples include the shale beaches of Lake Champlain and some of the Taconics.

Locally calcareous quartzose metasandstones, slates, and schists: The Monkton Formation is an example.

METASEDIMENTARY ROCKS, RARELY CALCAREOUS

Slates, graywackes, and conglomerates: Metamorphosed clastic sedimentary rocks—including rocks rich in quartz and feldspar—of the Taconics and western foothills of the Green Mountains.

Schists, phyllites, granofels, and related gneiss: Although generally non-calcareous, these rocks can be locally calcareous, capable of supporting rich-site species or natural communities, especially when topography and hydrology serve to amplify enrichment.

Quartzite, quartzose metasandstones and paragneiss: These rocks are notable for their resistance to weathering and limited availability of calcium and other important plant nutrients. The Cheshire Quartzite is an example.

MAFIC AND ULTRAMAFIC ROCKS

Mafic plutonic and related rocks: Mafic rocks are rich in iron, magnesium, and sometimes calcium and other metals. Although these elements are tied up in slow weathering minerals, topography and hydrology can serve to amplify ecological enrichment.

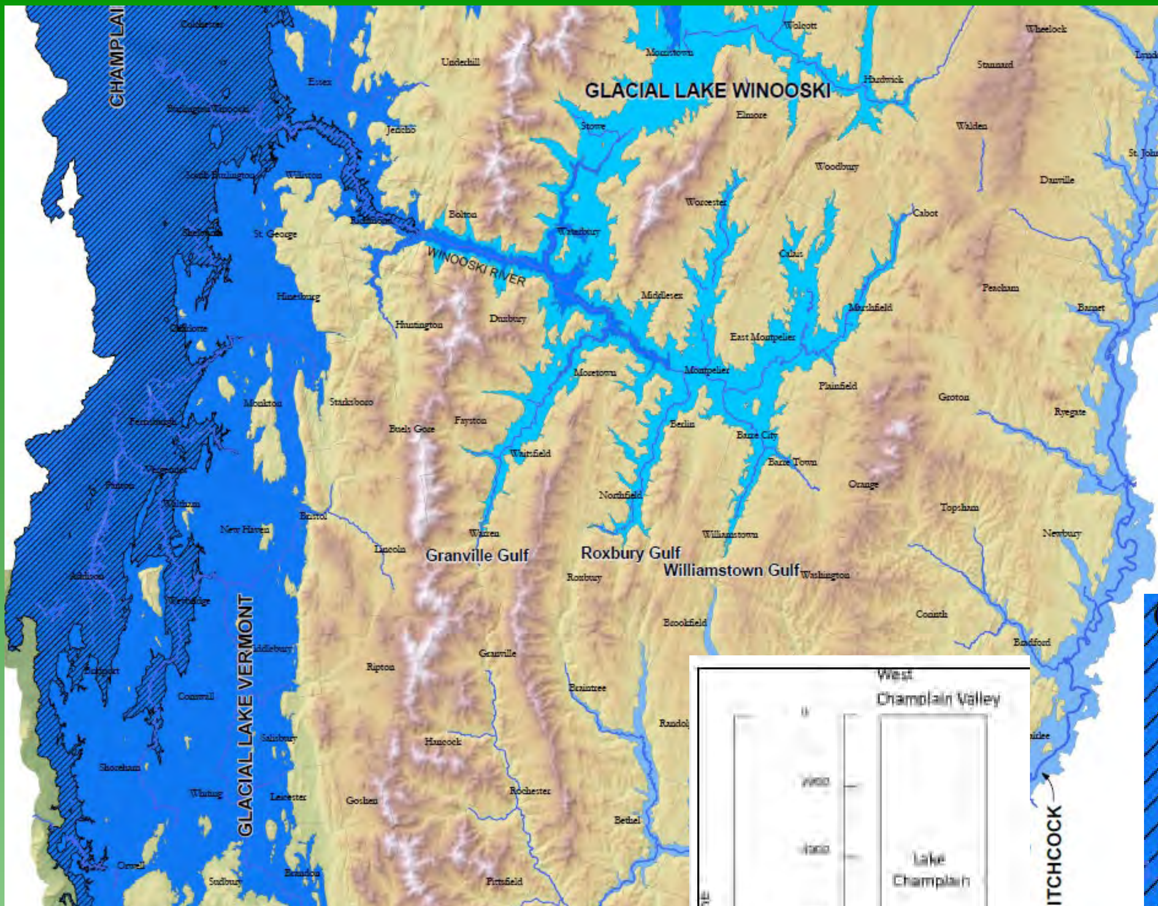
Mafic schist and amphibolite: Metamorphosed mafic volcanic and related rocks. Many of these rocks also contain minor dispersed calcium carbonate.

Ultramafic rocks: These unusual rocks have their origins deep beneath the oceanic crust and can be exceptionally rich in iron, magnesium, nickel and other heavy metals that are toxic to some plants. In Vermont, these rare rocks can support distinctive natural communities and rare plants. These rocks include serpentinite (the source of asbestos) and steatite (the source of soapstone).

FELSIC IGNEOUS AND PLUTONIC ROCKS

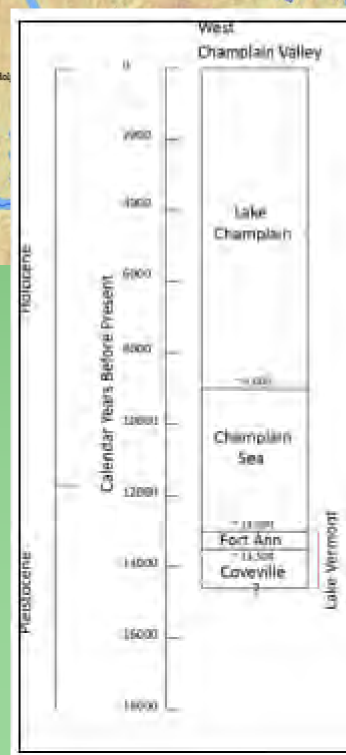
Felsic plutonic rocks: Felsic rocks are rich in quartz, feldspar and aluminum, and are non- calcareous. These rocks rose as magma through the earth's crust mainly during the Acadian Orogeny. They are generally resistant to weathering and when embedded in softer rock, they often form dome-shaped highpoints in a landscape. Black Mountain in Dummerston and the granite hills of Groton State Forest are notable examples.

Felsic, granitic gneiss: Metamorphosed granites, similar in composition to felsic plutonic rocks, but without the domelike tendencies and topographical character.



Legend

- Champlain Sea
- Glacial Lake Vermont
- Glacial Lake Winooski
- Glacial Lake Hitchcock
- Town Boundary
- National Hydrography Dataset streams/rivers



MAJOR GLACIAL LAKES
AND
THE CHAMPLAIN SEA, VERMONT
2020

by

George Springston, Norwich University,
Stephen Wright, University of Vermont and
John Van Hoesen, Green Mountain College

VERMONT
AGENCY OF NATURAL RESOURCES
Vermont Geological Survey

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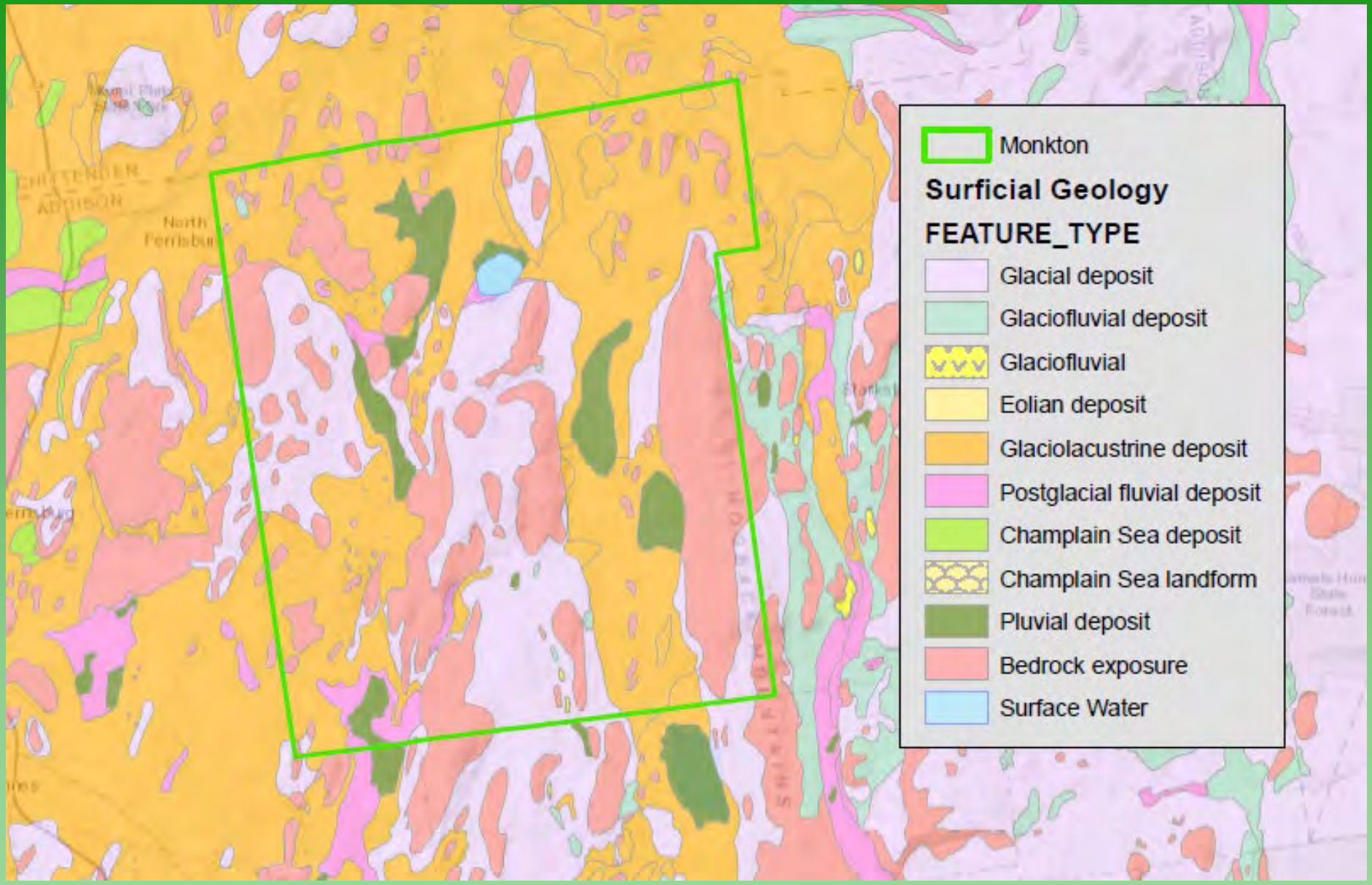
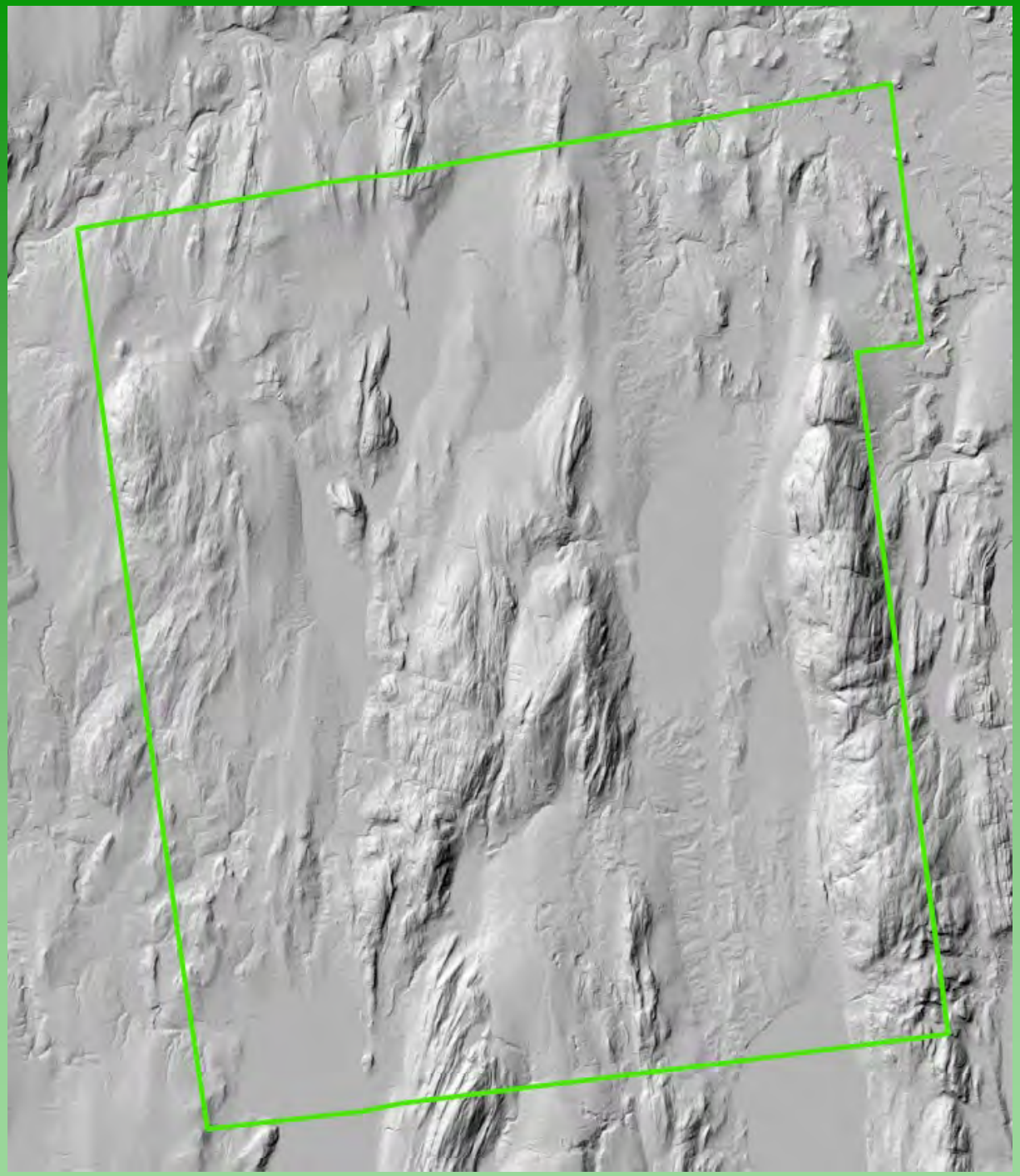
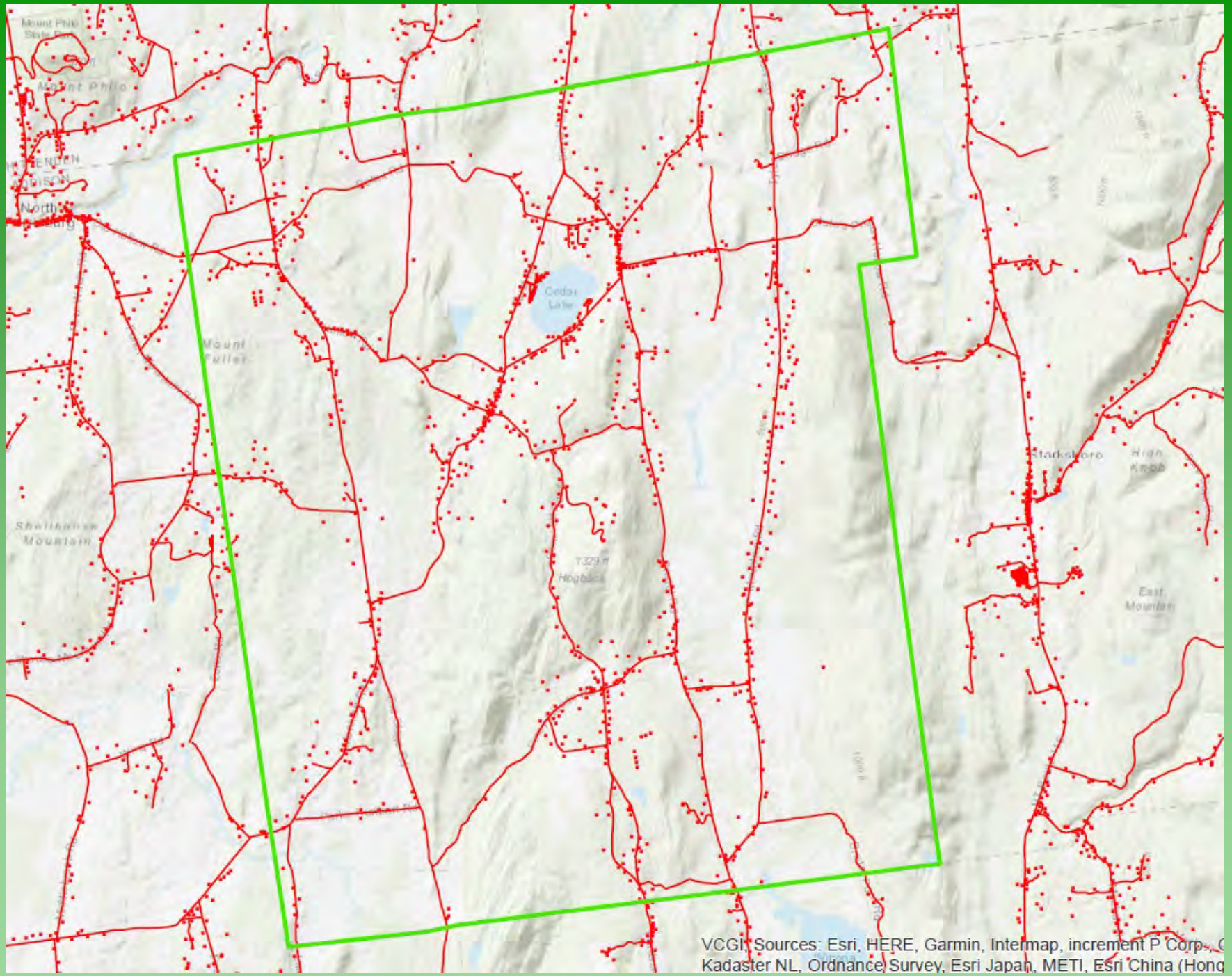
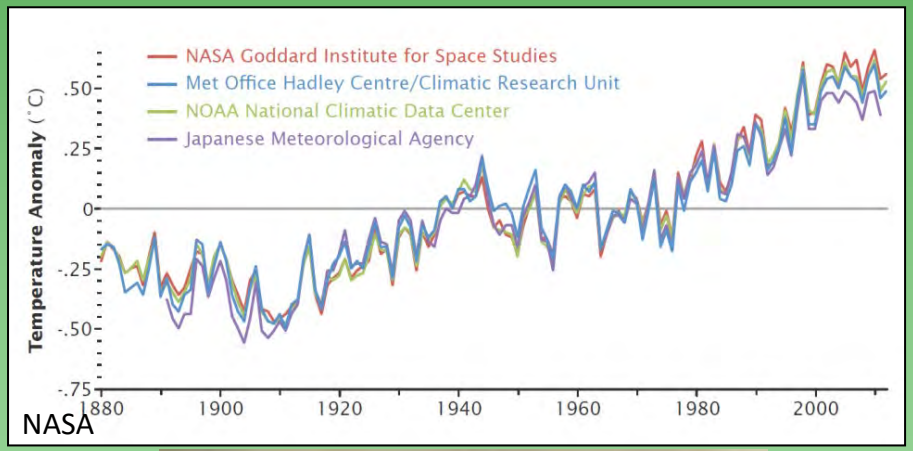

Monkton
Surficial Geology
FEATURE_TYPE
Glacial deposit
Glaciofluvial deposit
Glaciofluvial
Eolian deposit
Glaciolacustrine deposit
Postglacial fluvial deposit
Champlain Sea deposit
Champlain Sea landform
Pluvial deposit
Bedrock exposure
Surface Water




Mount Philo
Cedar Lake
Starksboro
High Knob
East Mountain
Shelburne Mountain
VCGI, Sources: Esri, HERE, Garmin, Intermap, increment P Corp.,
Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong

Threats to Biological Diversity

- Population growth
- Habitat loss
- Habitat fragmentation
- Non-native, invasive species
- Climate change – direct and compounding effects

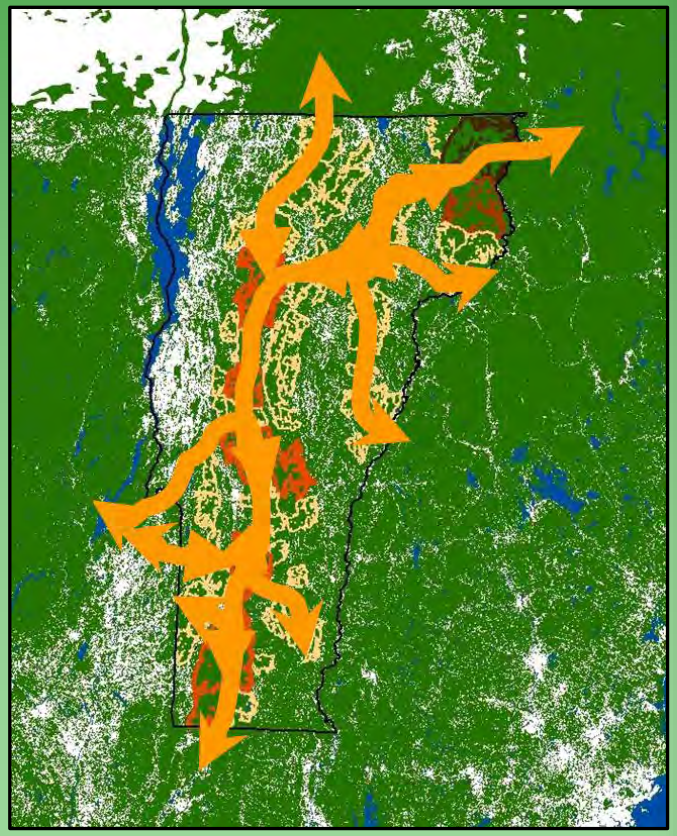


NASA

New!

Climate Change

- rapid and uncertain change
- species will shift independently
- need connectivity – species and processes
- need to "conserve nature's stage" – physical landscape



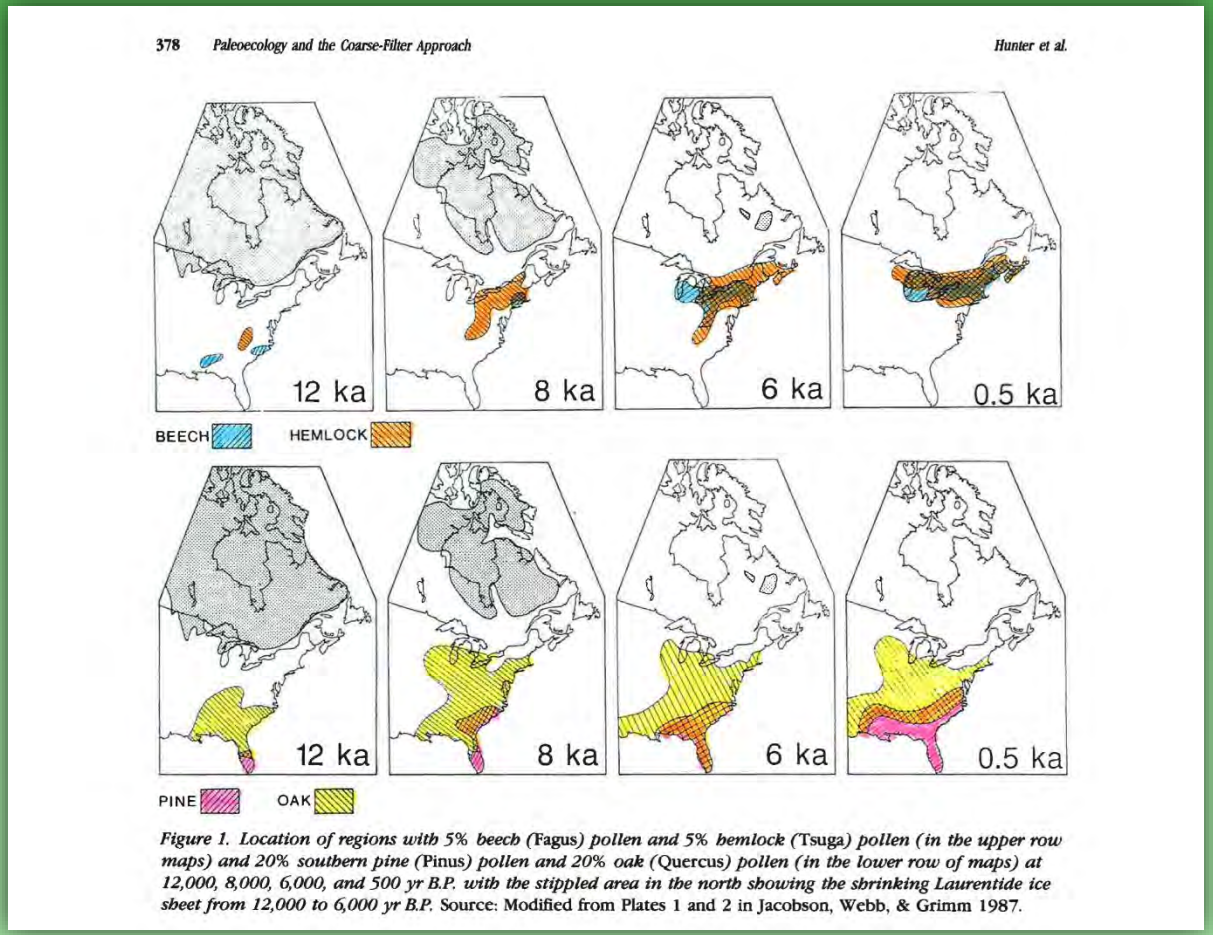
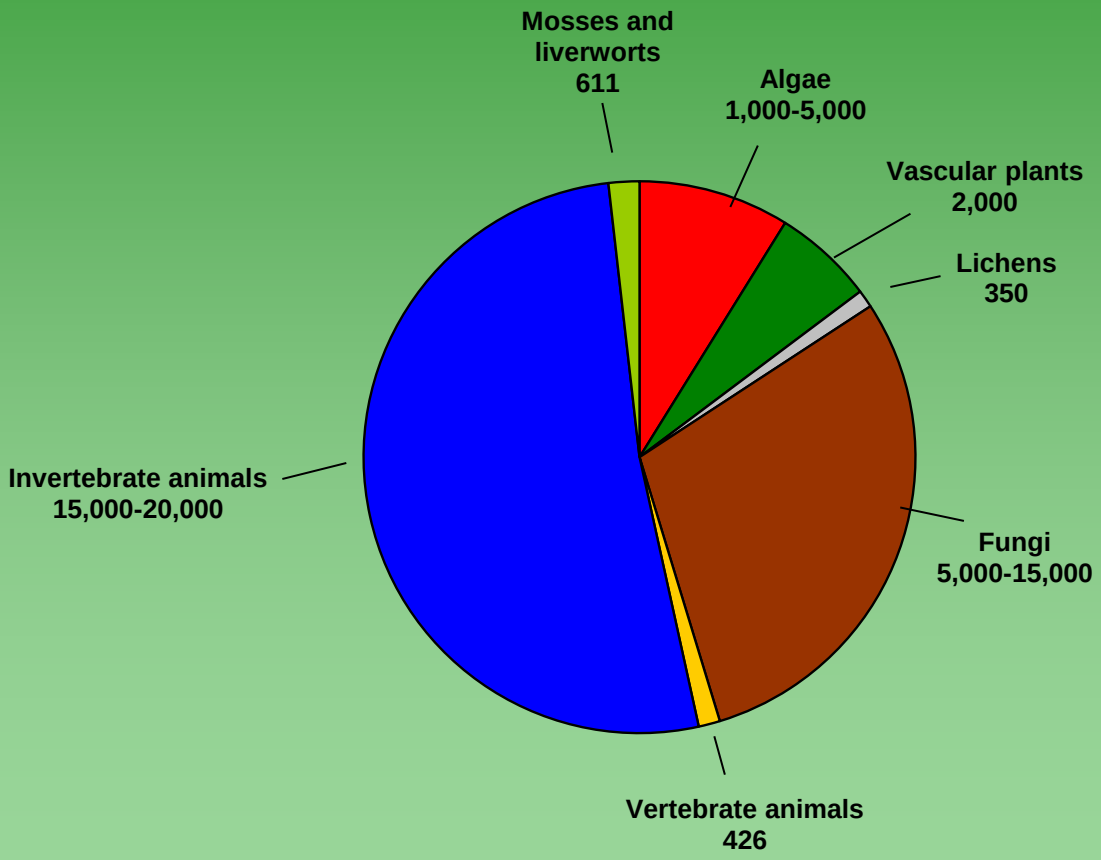


*Figure 1. Location of regions with 5% beech (*Fagus*) pollen and 5% hemlock (*Tsuga*) pollen (in the upper row maps) and 20% southern pine (*Pinus*) pollen and 20% oak (*Quercus*) pollen (in the lower row of maps) at 12,000, 8,000, 6,000, and 500 yr B.P. with the stippled area in the north showing the shrinking Laurentide ice sheet from 12,000 to 6,000 yr B.P.* Source: Modified from Plates 1 and 2 in Jacobson, Webb, & Grimm 1987.

An estimated 24,000 to 43,500 species in Vermont!

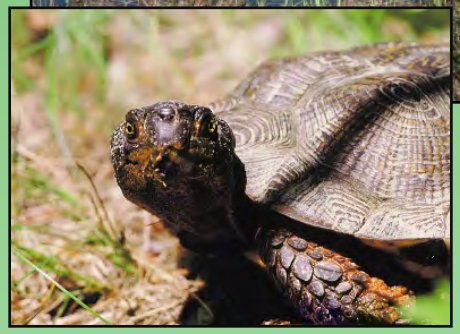
How do we protect them all?



Elfin Skimmer

Coarse filter/fine filter approach to conservation

- ***Well-recognized, efficient approach to conservation***
- ***Originally a combination of natural communities & species conservation efforts***



We need coarser filters

Vermont Conservation Design

A practical, scientific vision for sustaining Vermont's ecologically functional landscape for the future.

- **Applies the coarse filter-fine filter approach**
- **Uses simple, recognizable features (forest blocks and riparian areas)**
- **Depends on thoughtful stewardship and management**

https://vtfishandwildlife.com/conserve/vermont-conservation-design

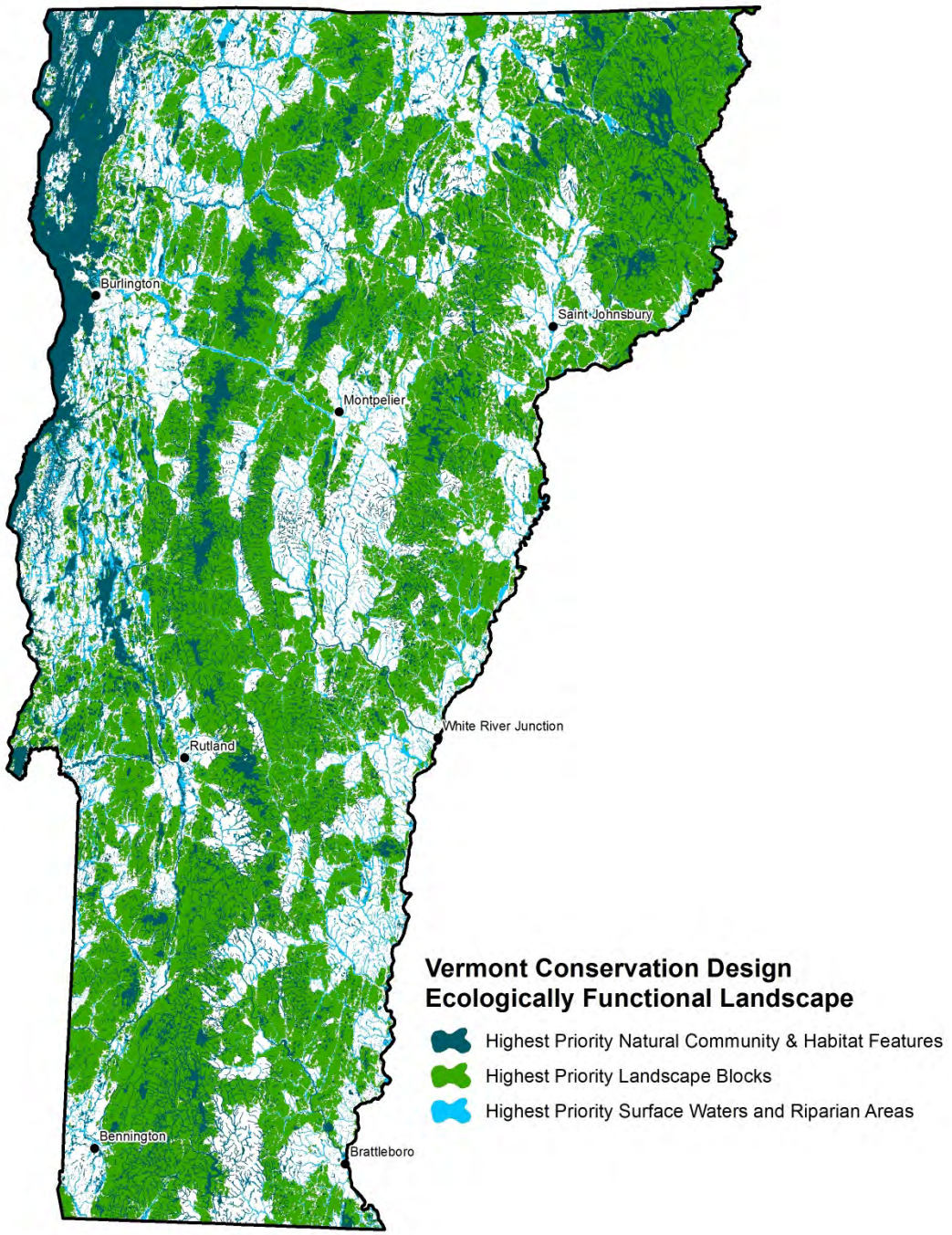
Collaborators:

VT Fish and Wildlife Department
Vermont Land Trust
The Nature Conservancy
VT Department of Forests, Parks & Recreation
VT Department of Environmental Conservation
Northwoods Stewardship Center
USDA Natural Resources Conservation Service

Ecologically Functional Landscape

- **Intact**
- **Connected**
- **Diverse**

A set of coarse-filter features which, if appropriately conserved and managed for their ecological functions, offer high confidence in maintaining biological diversity and ecological processes into the future.



Conservation Design at Three Scales

Landscapes

Interior Forest Blocks
Connectivity Blocks
Surface Waters and Riparian Areas
Riparian Areas for Connectivity
Physical Landscapes
Wildlife Road Crossings

Natural Communities

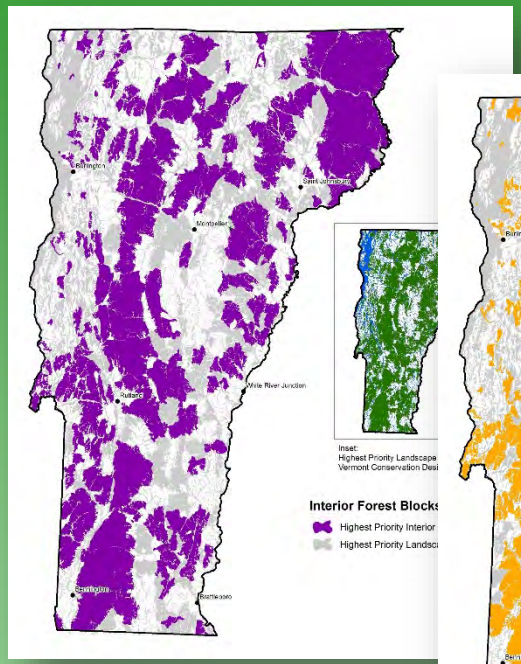
Natural Communities
Young and Old Forest
Aquatic Habitats
Wetlands
Grasslands/Shrublands
Underground Habitats

Species

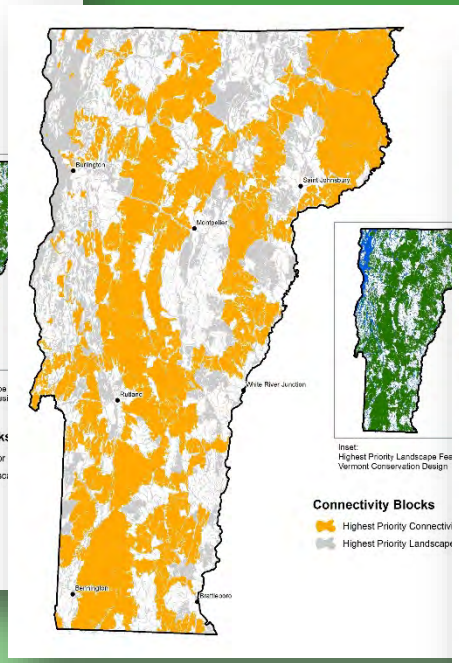
Species with very specific biological needs that will likely always require individual attention

Intact and Connected Forest Blocks Surface Waters and Riparian Areas

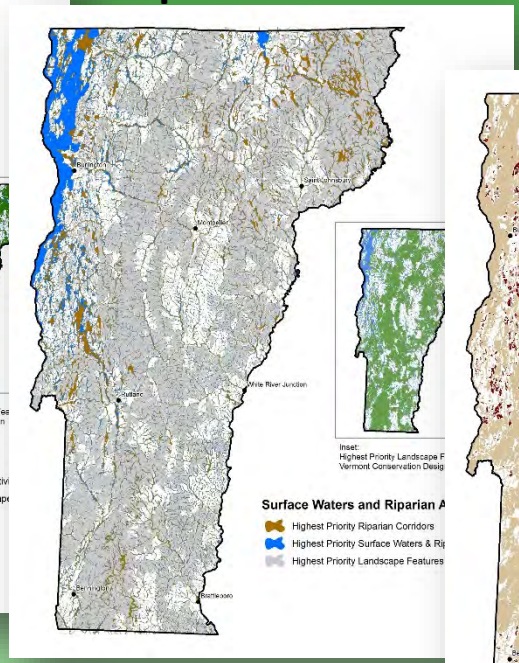
Interior Forest Blocks



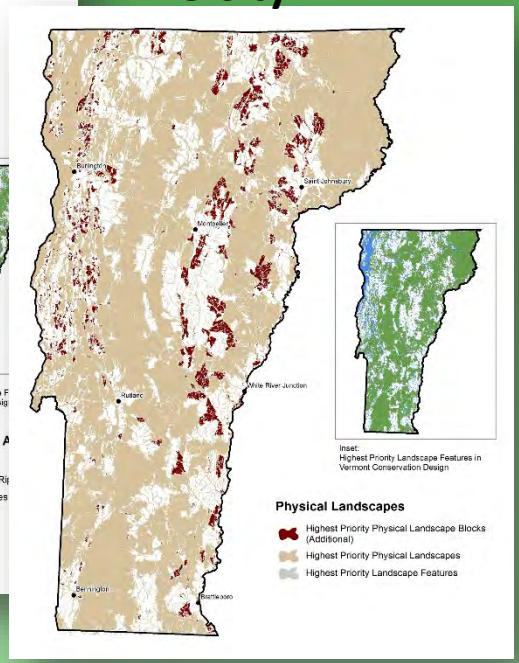
Connectivity Blocks



Surface Waters and Riparian Areas



Physical Landscape Diversity



Wildlife Road Crossings

Maintain the specific functions of each element

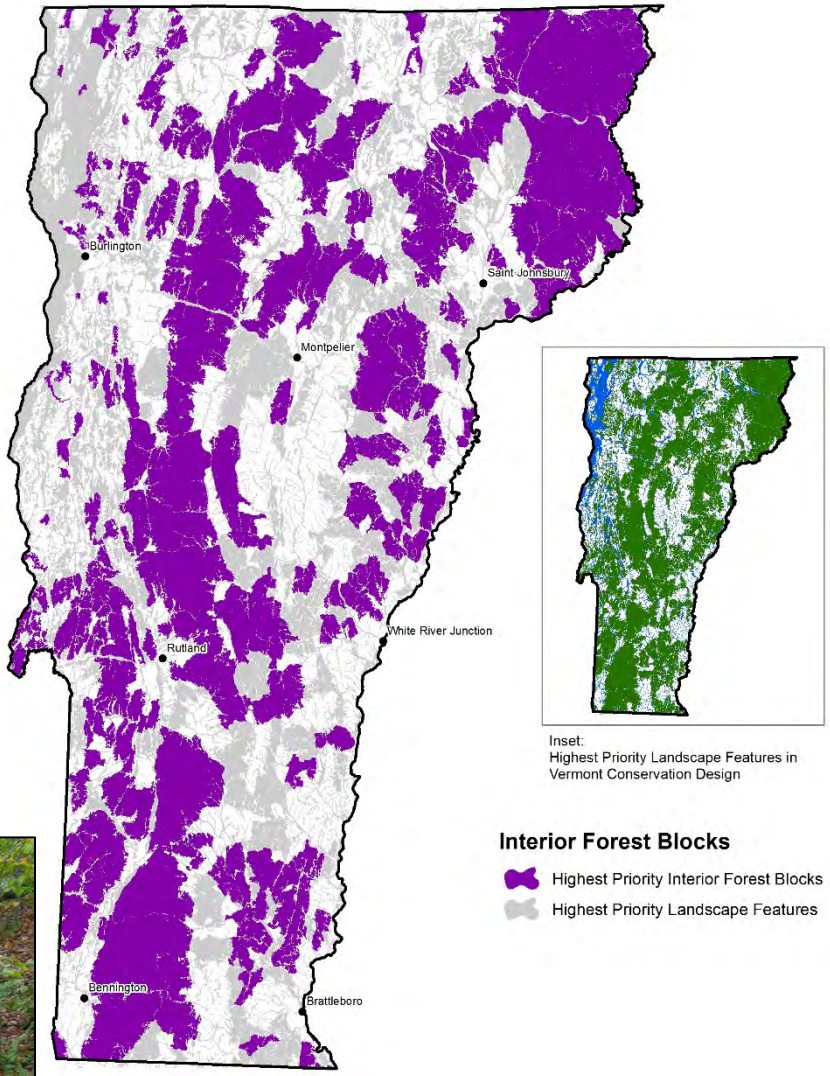
Interior Forest Blocks

The best examples of interior forest in each region of Vermont

Places where species and ecological process exist with minimal disturbance

Ecological functions:

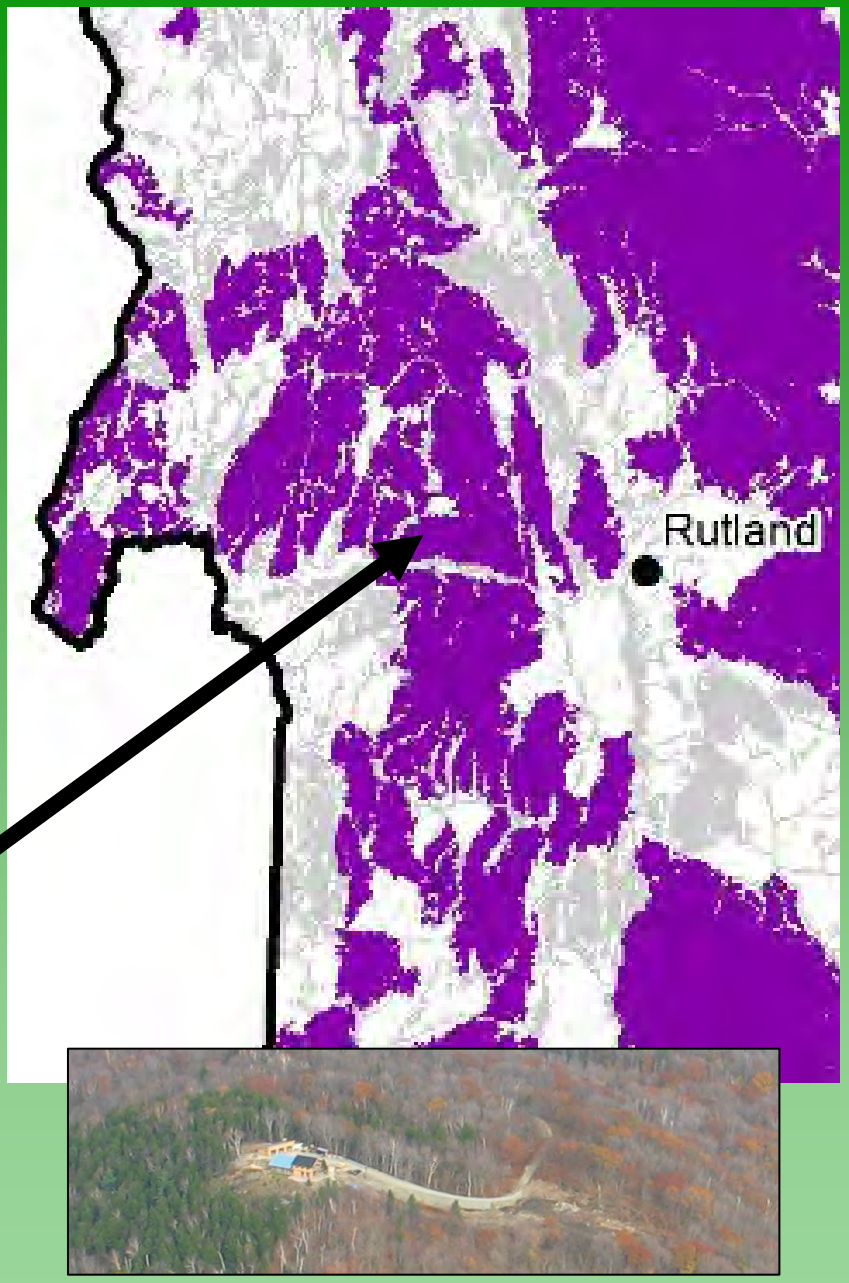
- Interior forest species
- Wide-ranging mammals
- Air and water quality
- Flood resilience
- Ecological processes
- Species can shift and adapt within blocks



Interior Forest Blocks

Guidelines for Maintaining Ecological Function:

- Avoid permanent interior fragmentation
- Limit development to the margins
- Maintain forest structure & distribution of age classes
- Minimize invasive species.



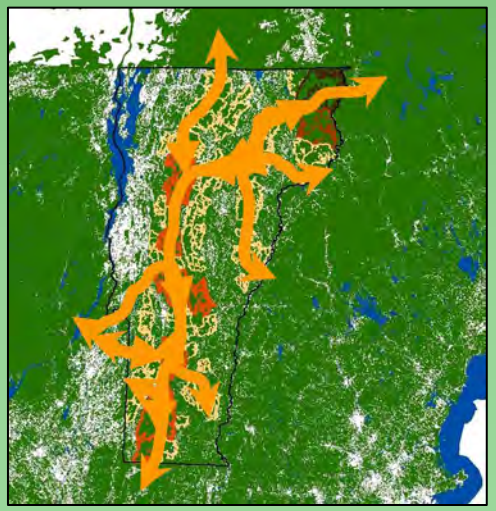
Connectivity Blocks

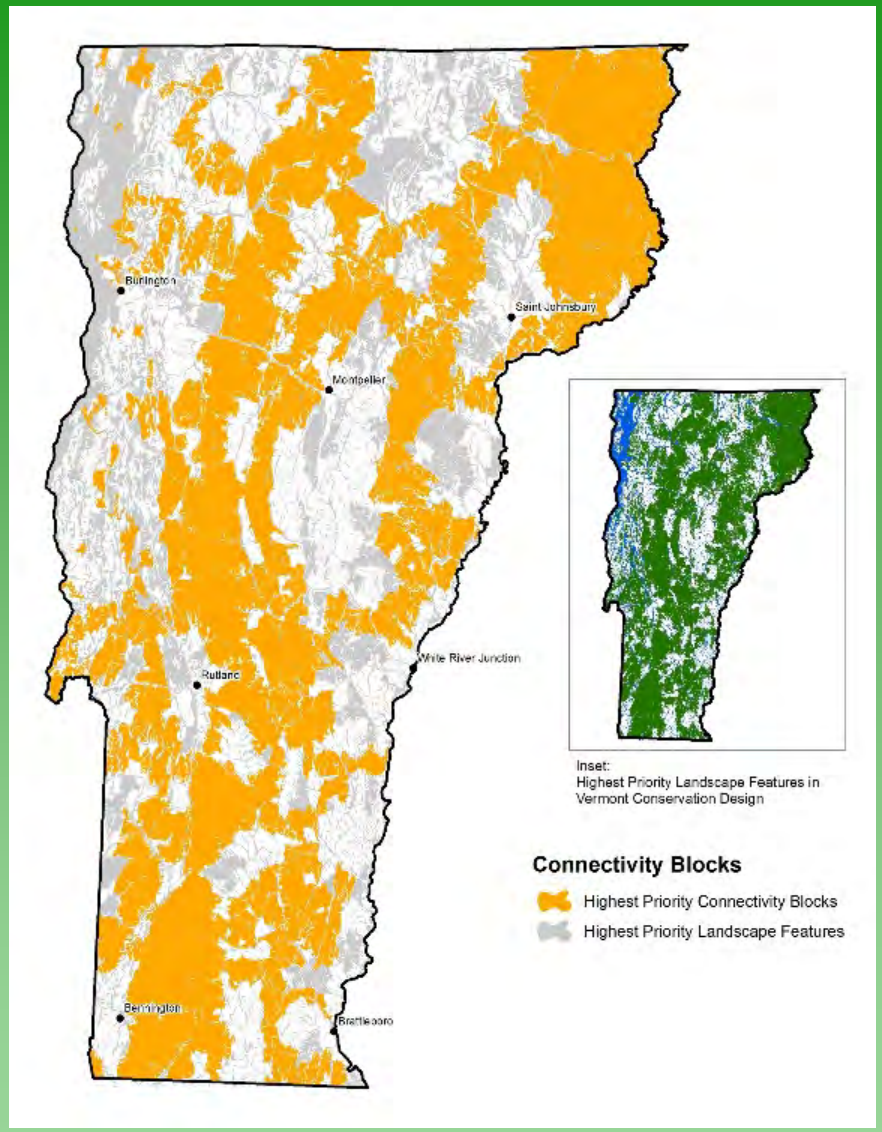
The network of forest blocks that are critical for wildlife movement and species ranges shifts

Connects within Vermont and to adjacent states and Québec

Ecological Functions:

- Wildlife movement and dispersal
- Habitat for wide-ranging mammals
- Genetic exchange
- Plant and animal range shifts in response to climate change
- Reduces extinction risks





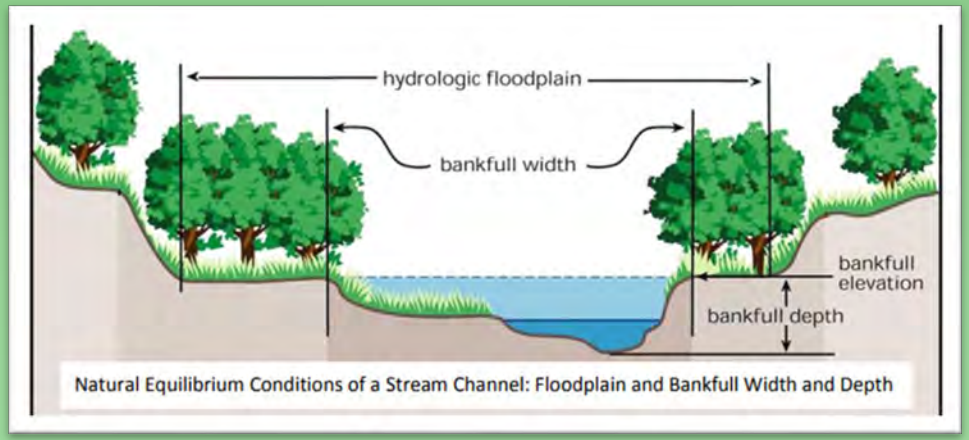
Surface Waters and Riparian Areas

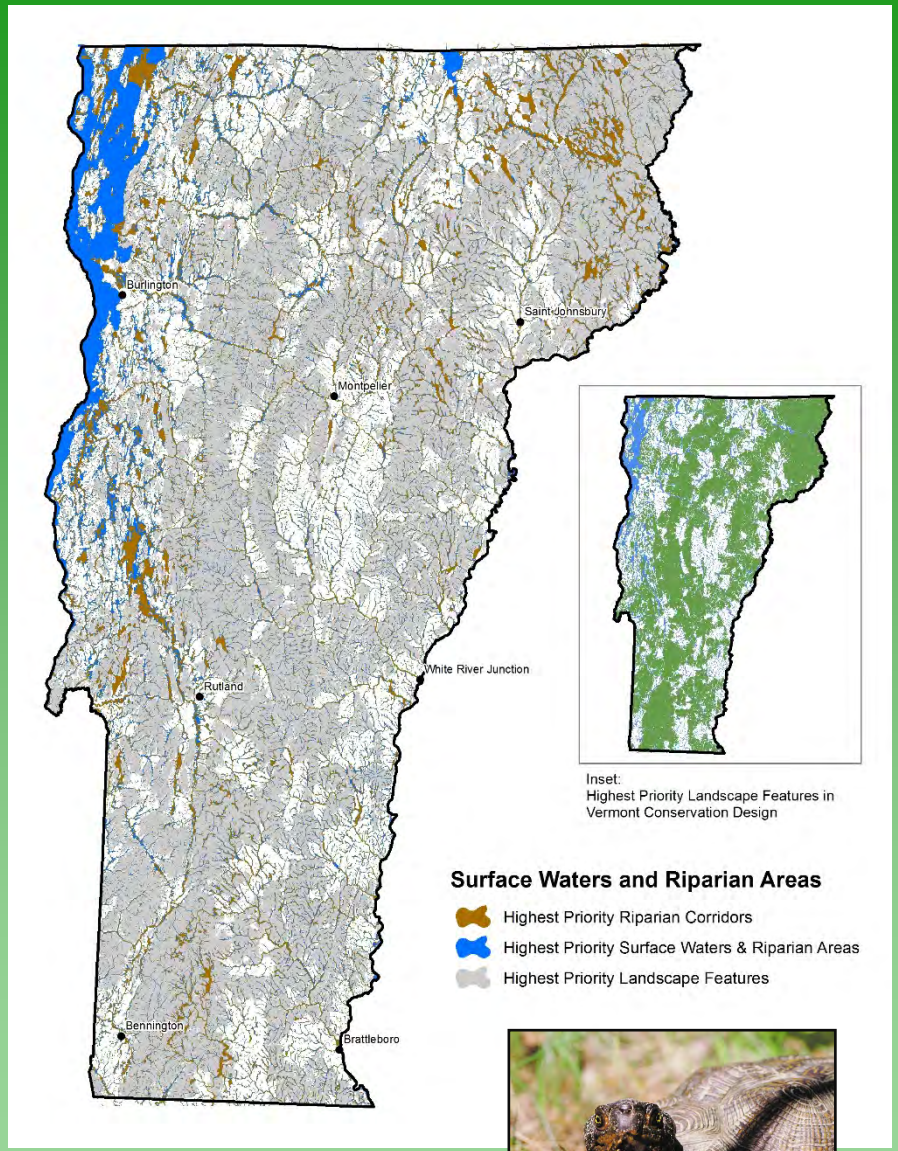
Every river, stream, lake, pond and riparian area in Vermont

Entire network contributes to biodiversity and ecological function

Ecological Functions:

- Habitat for aquatic species
- Water quality
- Flood protection
- Terrestrial species habitat
- Wildlife movement
- Plant and animal range shifts in response to climate change

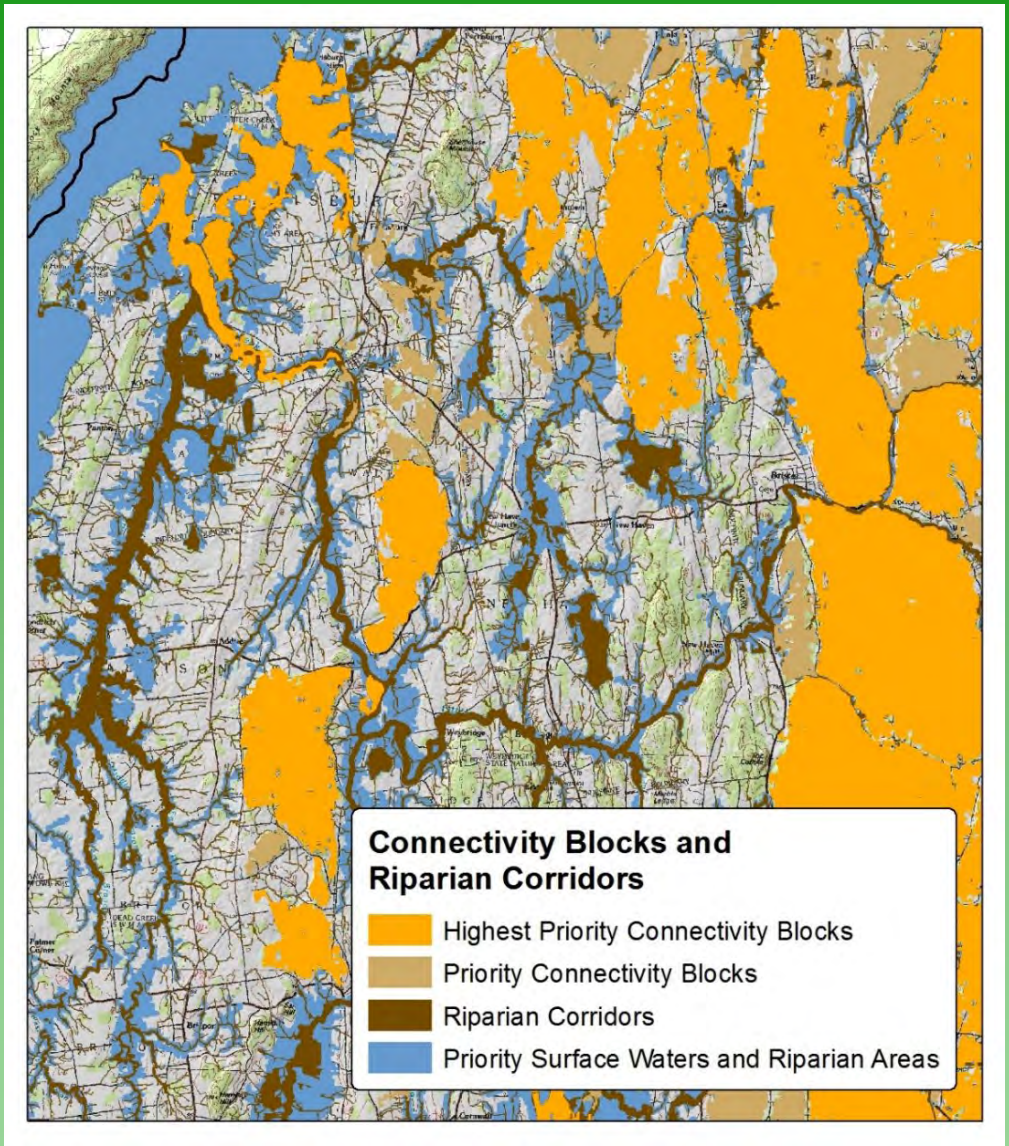




Riparian Connectivity

In parts of the state, riparian areas are the only connections between forest blocks

We need to restore riparian vegetation.



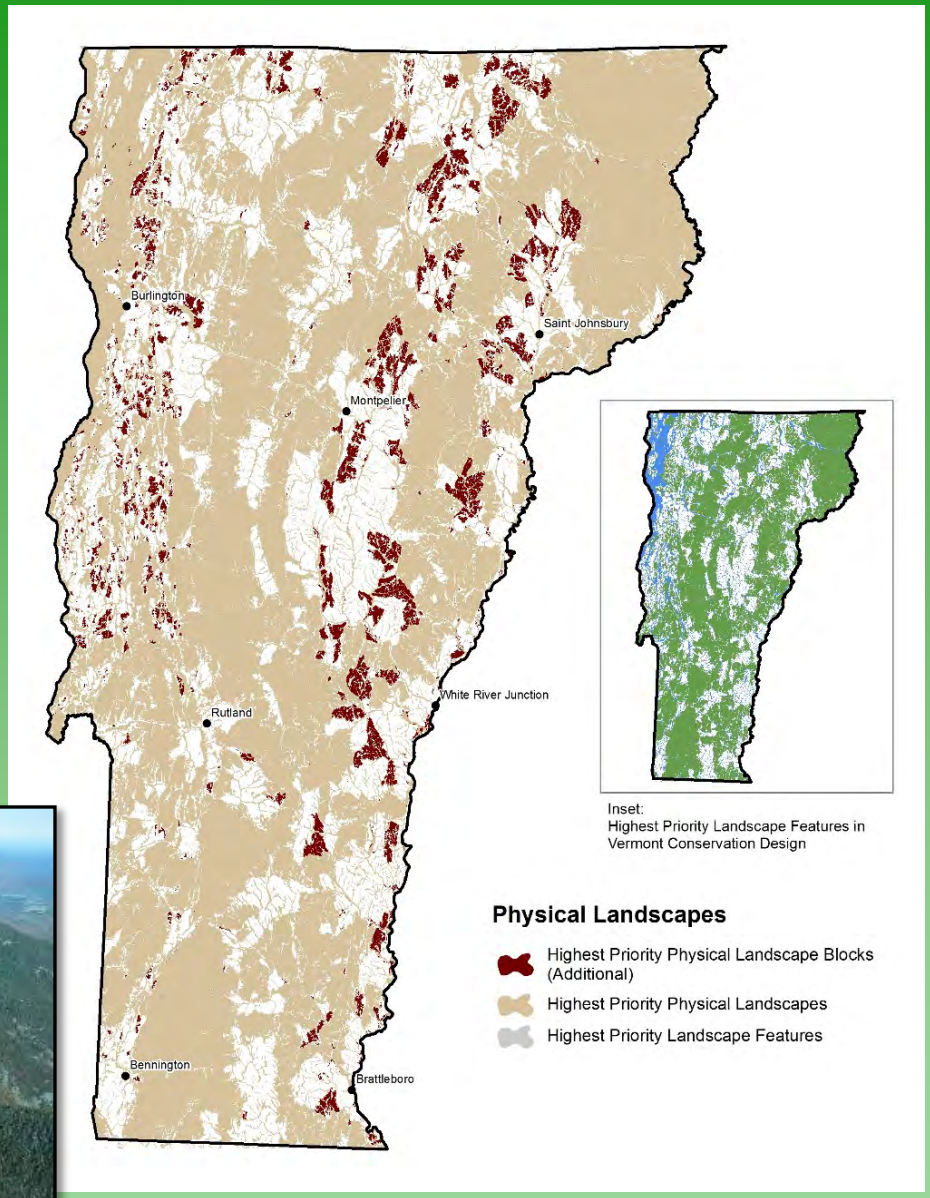
Physical Landscape Diversity

A set of forest blocks that ensure we conserve Vermont's full diversity of elevation, geology, and landforms

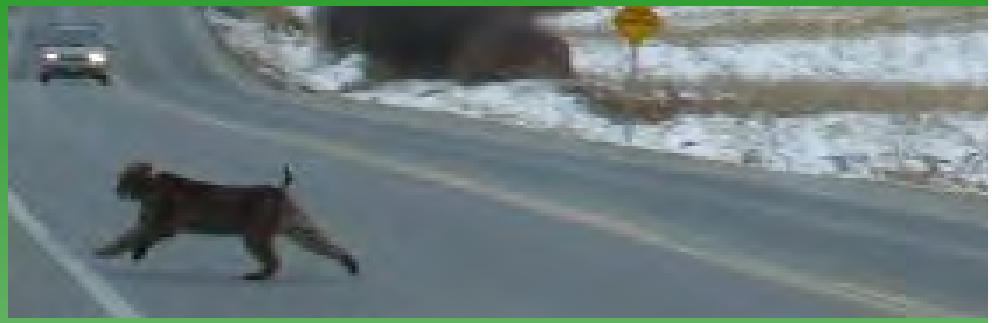
"Conserve nature's stage"

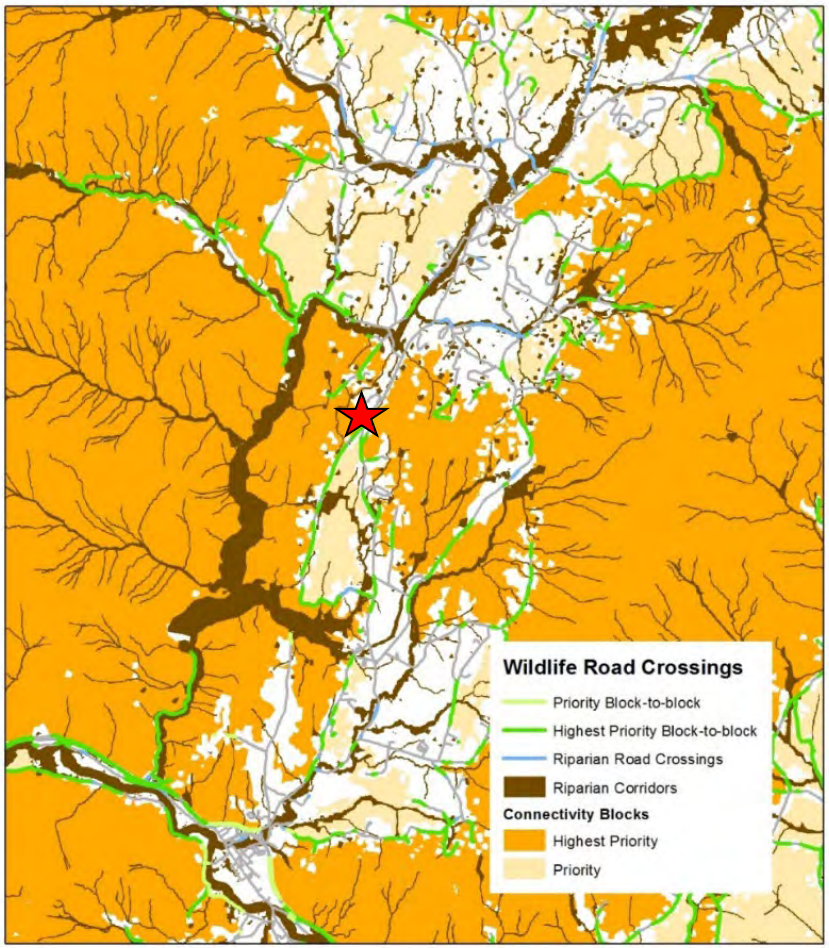
Ecological functions:

- Habitat for species that use specific physical settings (e.g. those found on calcium-rich rock)
- Species can shift to new settings in a changing climate



Wildlife Road Crossings





Wildlife Road Crossings

Jim Andrews photos

Conservation Design at Three Scales

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Natural Communities

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Wetlands
Grasslands/Shrublands
Underground Habitats

Species

Species with very specific biological needs that will likely always require individual attention

Natural Communities

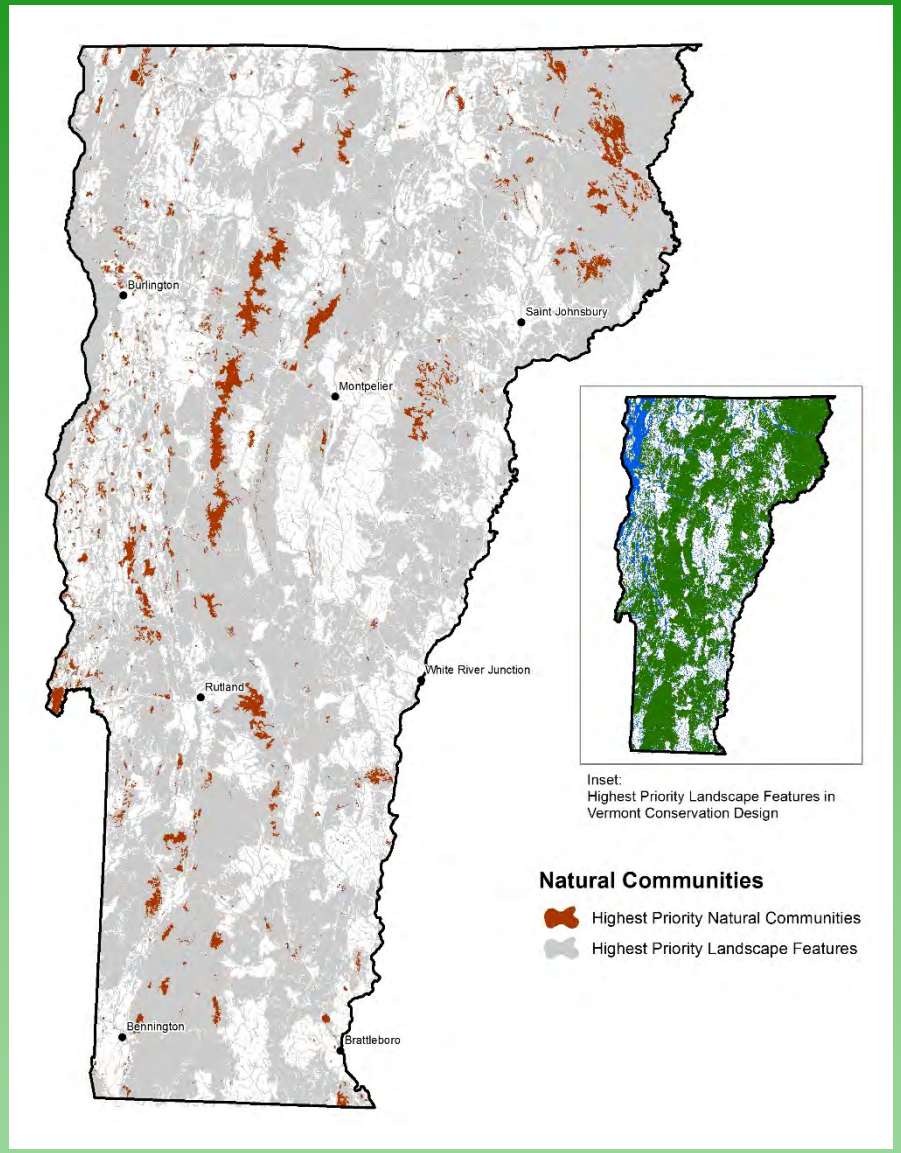
Vermont's original natural habitats

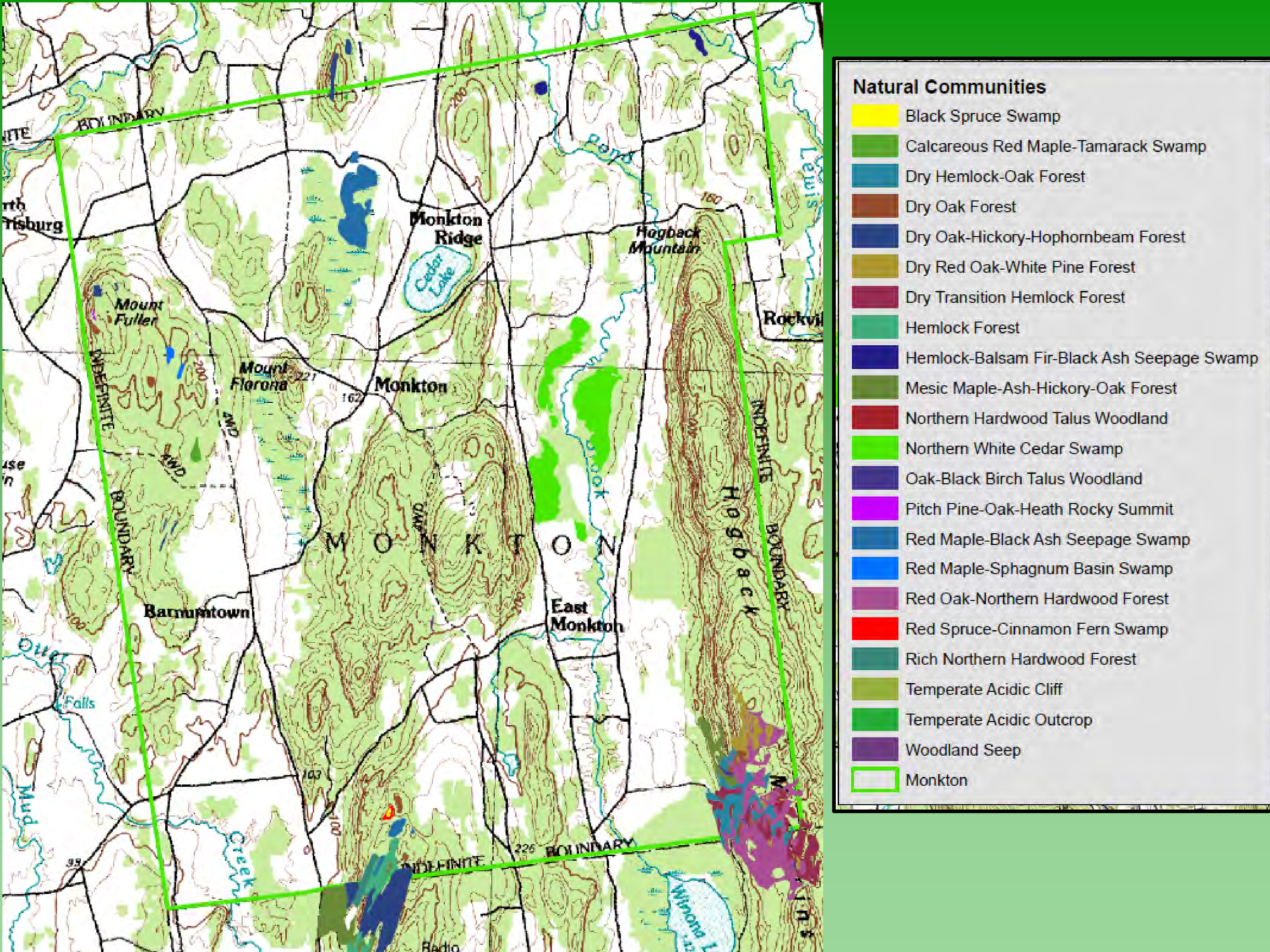
All examples of rare types and 50% of the examples of more common types

Matrix forests conserved by forest blocks and old forests

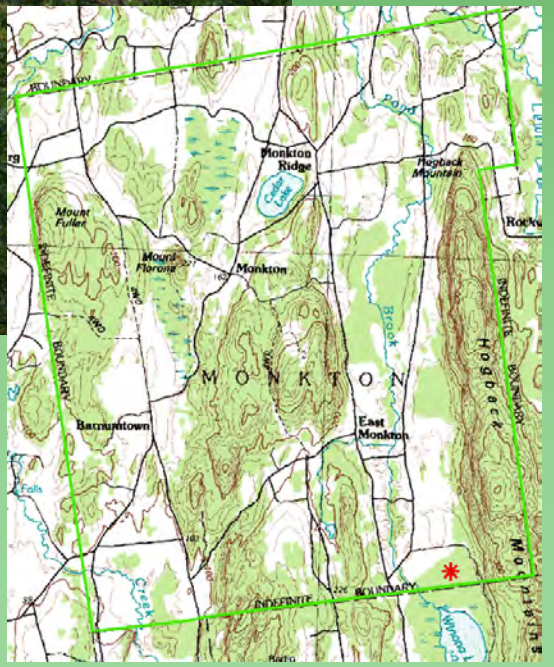
Ecological Functions:

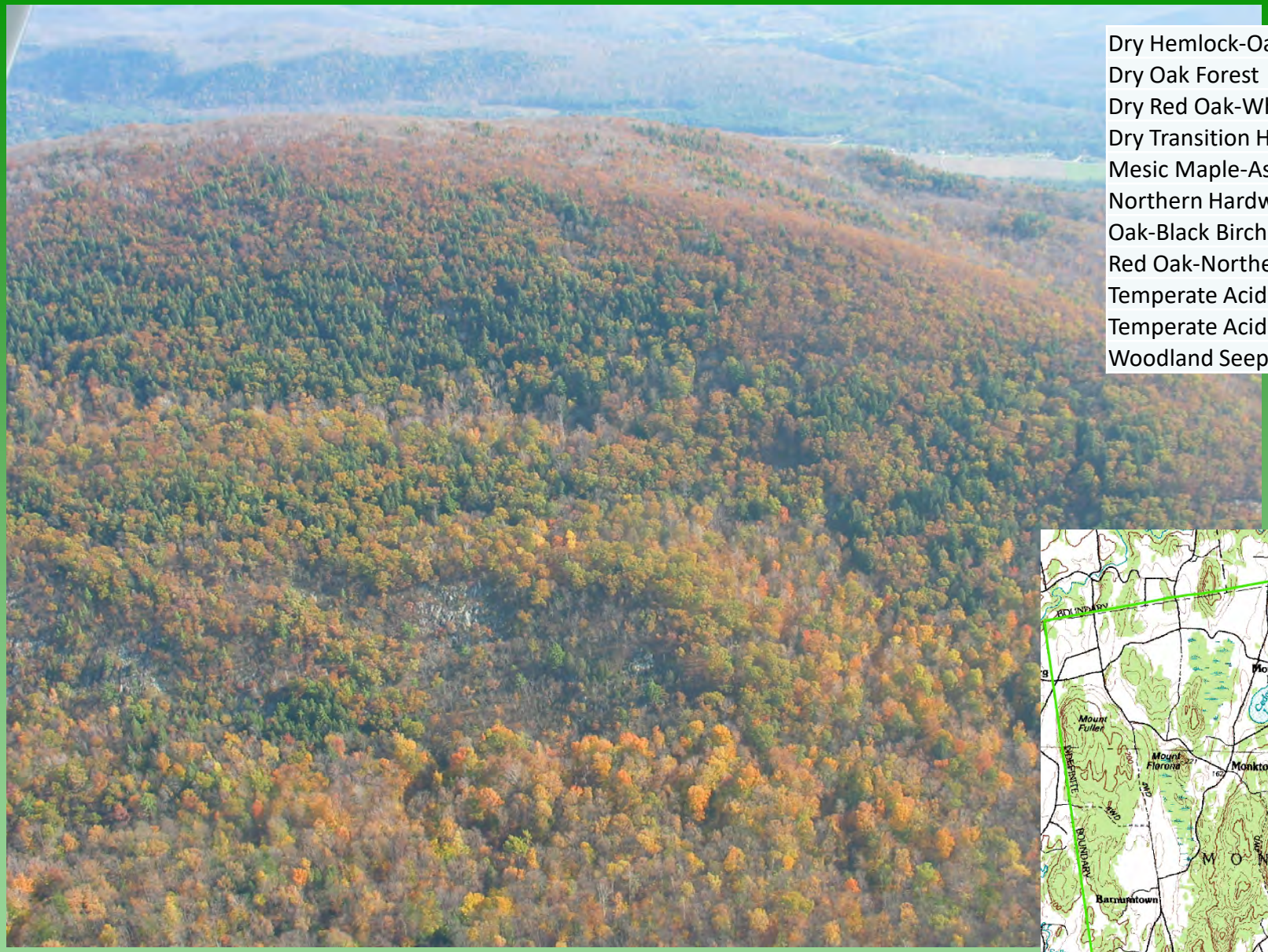
- Coarse filters for most of our native species
- Places that will always support unique assemblages of biodiversity, even in a changing climate



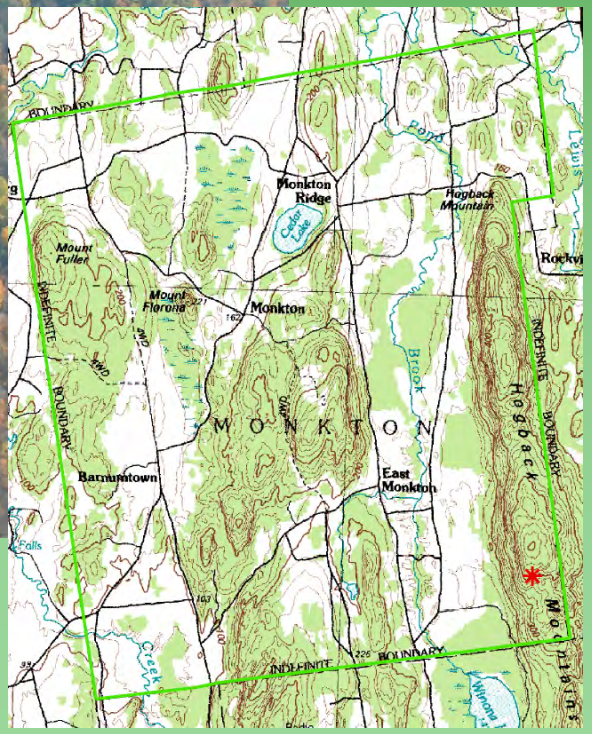


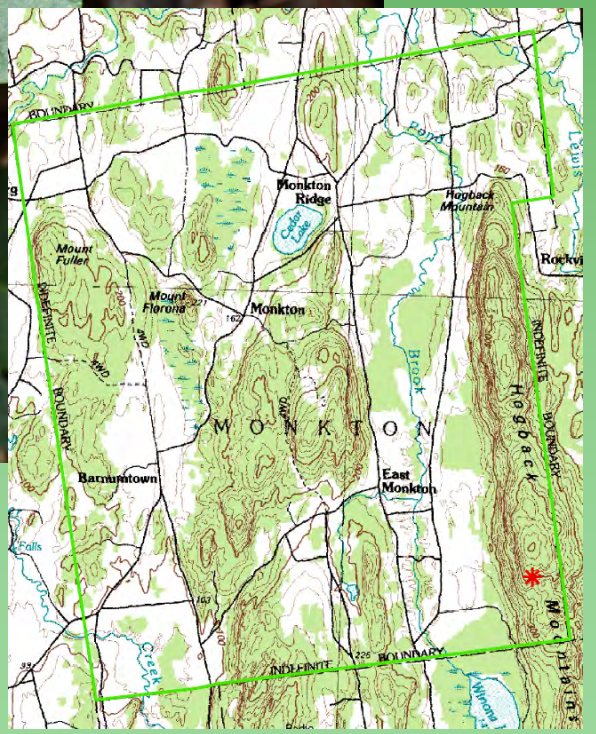
Natural Communities
Black Spruce Swamp
Calcareous Red Maple-Tamarack Swamp
Dry Hemlock-Oak Forest
Dry Oak Forest
Dry Oak-Hickory-Hophornbeam Forest
Dry Red Oak-White Pine Forest
Dry Transition Hemlock Forest
Hemlock Forest
Hemlock-Balsam Fir-Black Ash Seepage Swamp
Mesic Maple-Ash-Hickory-Oak Forest
Northern Hardwood Talus Woodland
Northern White Cedar Swamp
Oak-Black Birch Talus Woodland
Pitch Pine-Oak-Heath Rocky Summit
Red Maple-Black Ash Seepage Swamp
Red Maple-Sphagnum Basin Swamp
Red Oak-Northern Hardwood Forest
Red Spruce-Cinnamon Fern Swamp
Rich Northern Hardwood Forest
Temperate Acidic Cliff
Temperate Acidic Outcrop
Woodland Seep
Monkton
Monkton Ridge
Cedar Lake
Hogback Mountain
Mount Fuller
Mount Florona
Monkton
M O N K T O N
East Monkton
Barnumtown
Hogback
INDEFINITE BOUNDARY
Pond
Brook
Lewis
Otter
Falls
Mud
Creek
Radio

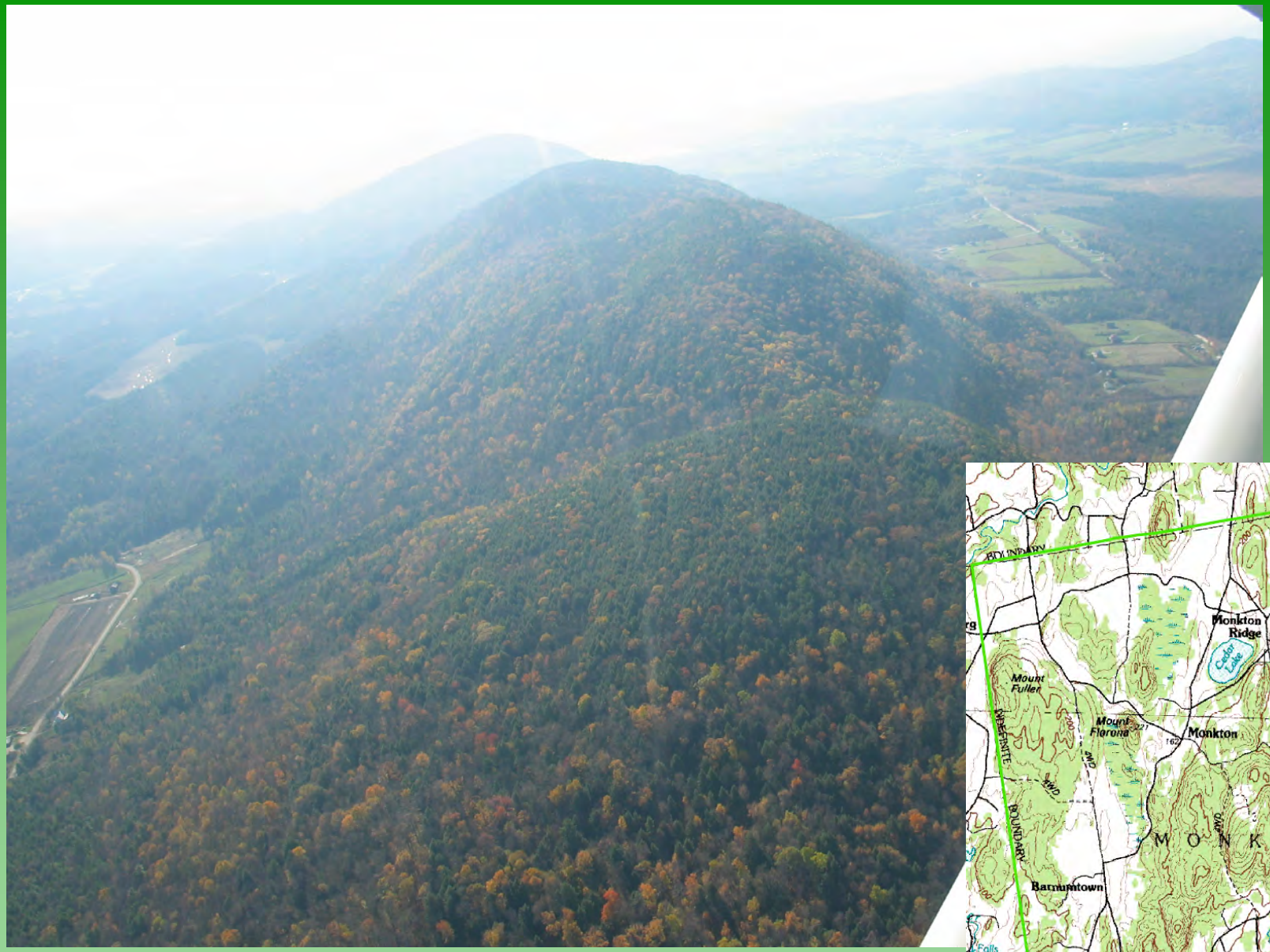

Monkton Ridge
Hogback Mountain
Mount Fuller
Mount Florona
Monkton
MONKTON
Barnumtown
East Monkton
Hogback Mountains
BOUNDARY

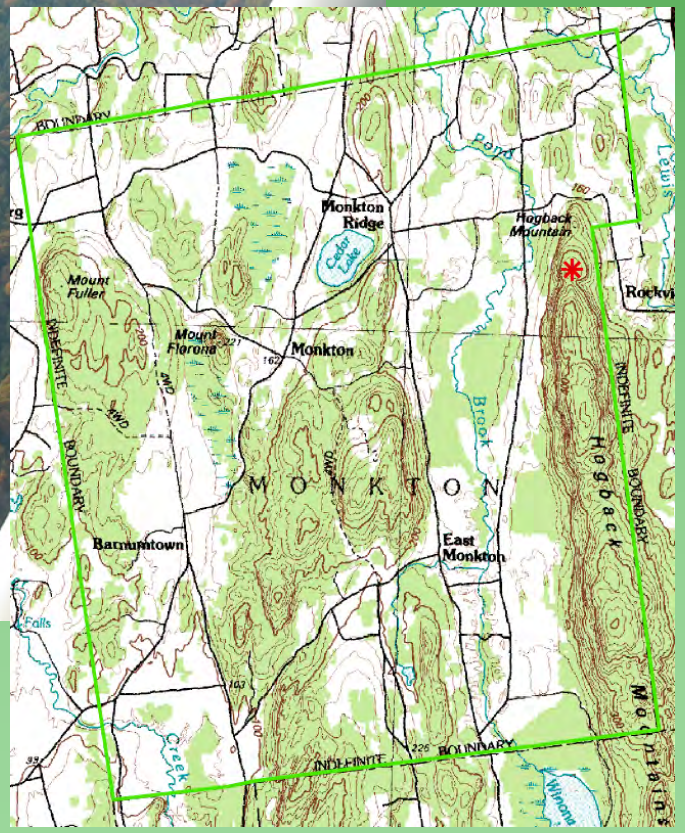


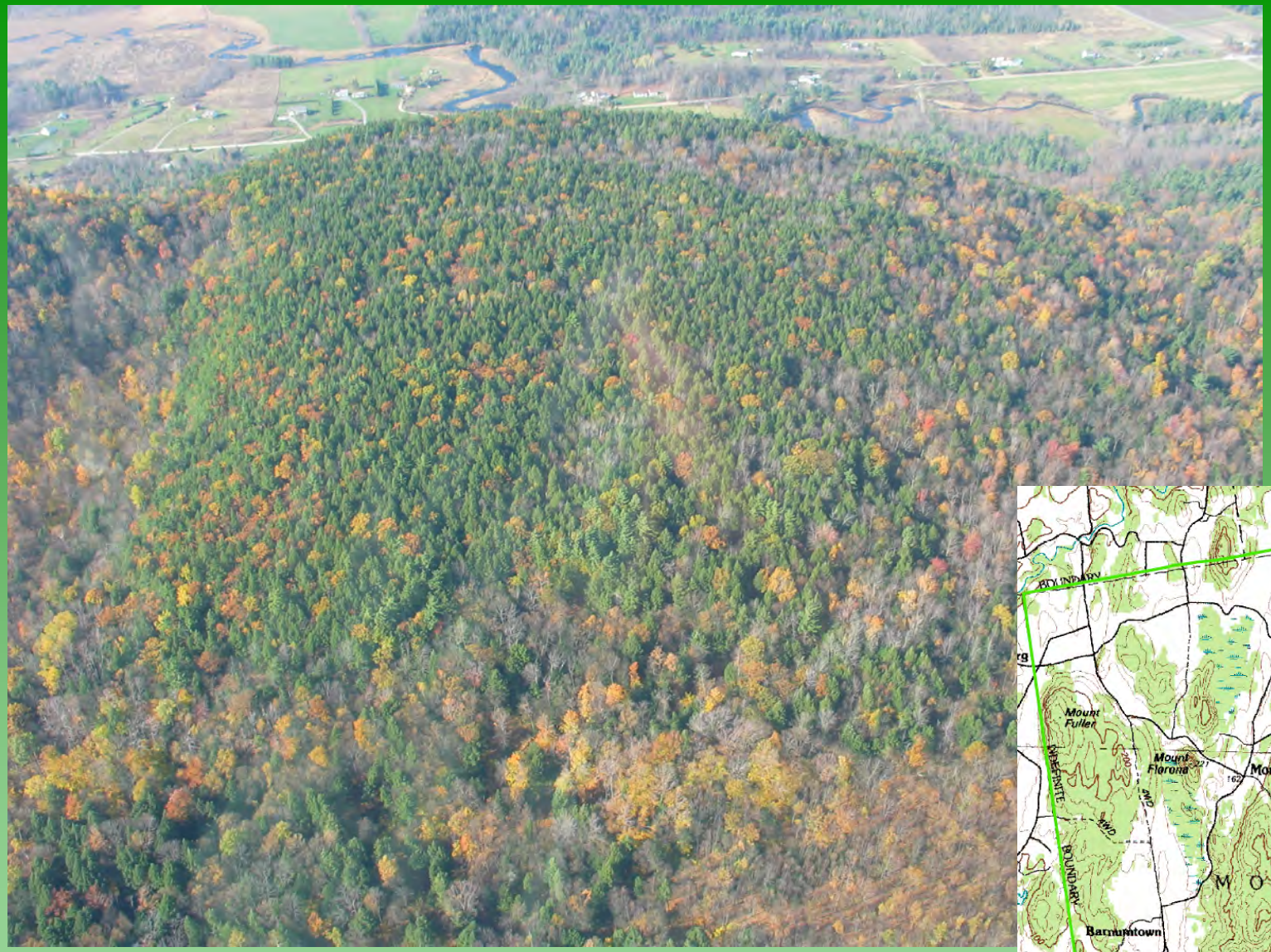
- Dry Hemlock-Oak Forest
- Dry Oak Forest
- Dry Red Oak-White Pine Forest
- Dry Transition Hemlock Forest
- Mesic Maple-Ash-Hickory-Oak Forest
- Northern Hardwood Talus Woodland
- Oak-Black Birch Talus Woodland
- Red Oak-Northern Hardwood Forest
- Temperate Acidic Cliff
- Temperate Acidic Outcrop
- Woodland Seep

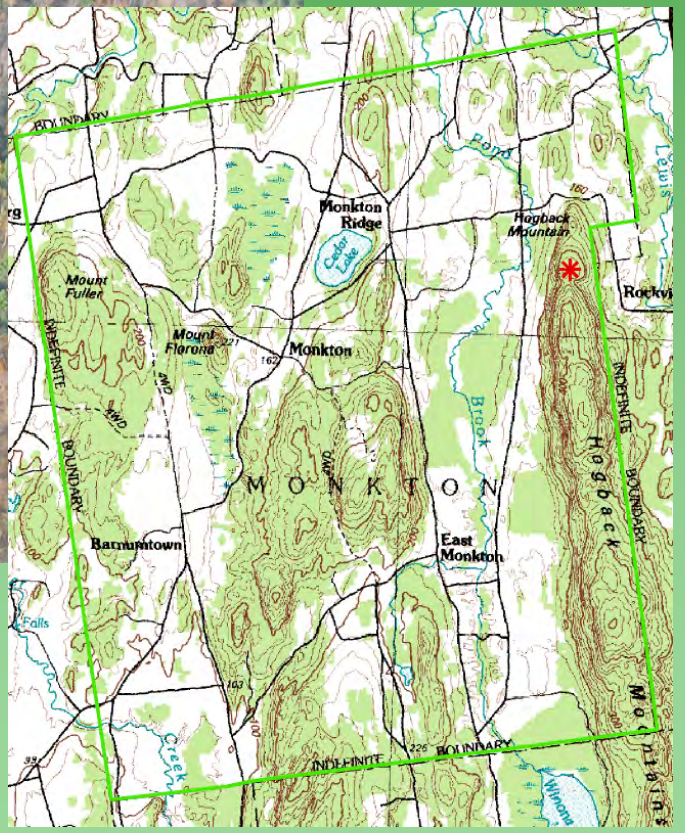



BOUNDARY
Monkton Ridge
Hogback Mountain
Cedar Lake
Mount Fuller
Mount Florona
Monkton
INDEFINITE
ROAD
Brook
MONKTON
Hogback
Barnumtown
East Monkton
Falls
Creek
INDEFINITE
BOUNDARY




BOUNDARY
Monkton Ridge
Hogback Mountain
Cedar Lake
Mount Fuller
Mount Florona
Monkton
INDEFINITE
BOUNDARY
Brook
M O N K T O N
Hogback
Barnumtown
East Monkton
Falls
Creek
INDEFINITE
BOUNDARY




Monkton Ridge
Hogback Mountain
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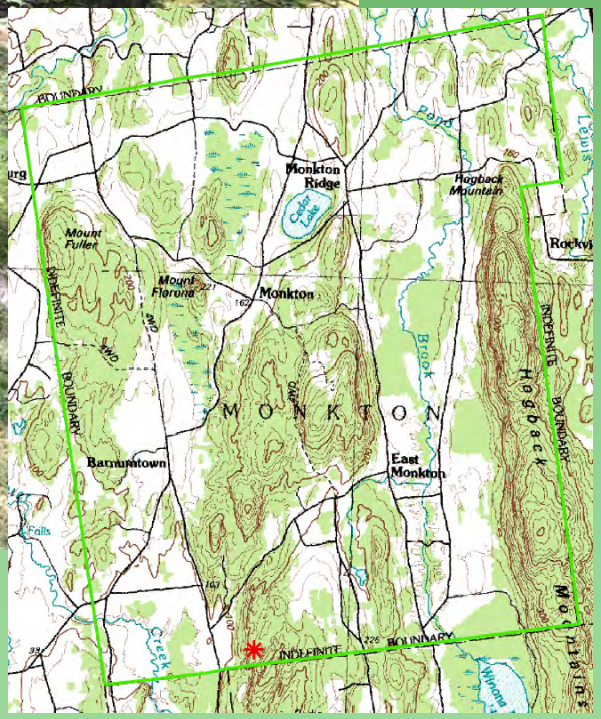
Hogback
Barnumtown
East Monkton
Falls
Creek
Brook
INDEFINITE
BOUNDARY


BOUNDARY
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Brook
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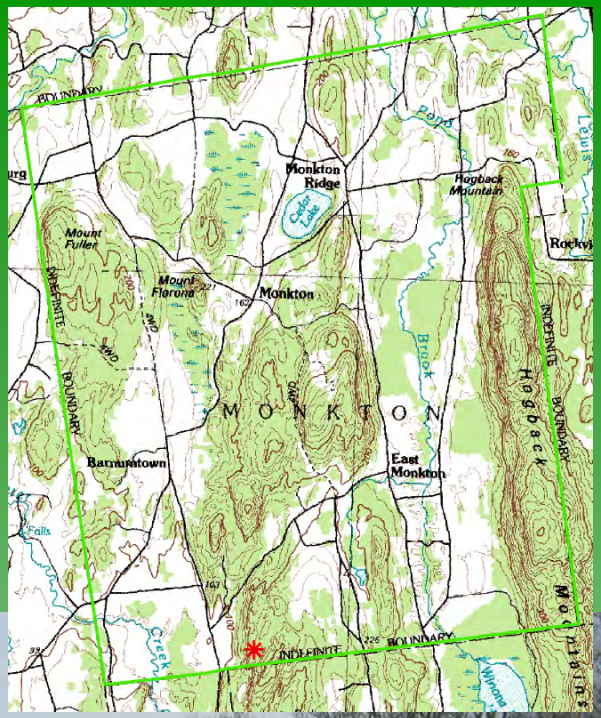
Hogback
Barnumtown
East Monkton
Falls
Creek
INDEFINITE
226
BOUNDARY
Winona
Mountain


BOUNDARY
Monkton Ridge
Hogback Mountain
Cedar Lake
Mount Fuller
Mount Florona
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Brook
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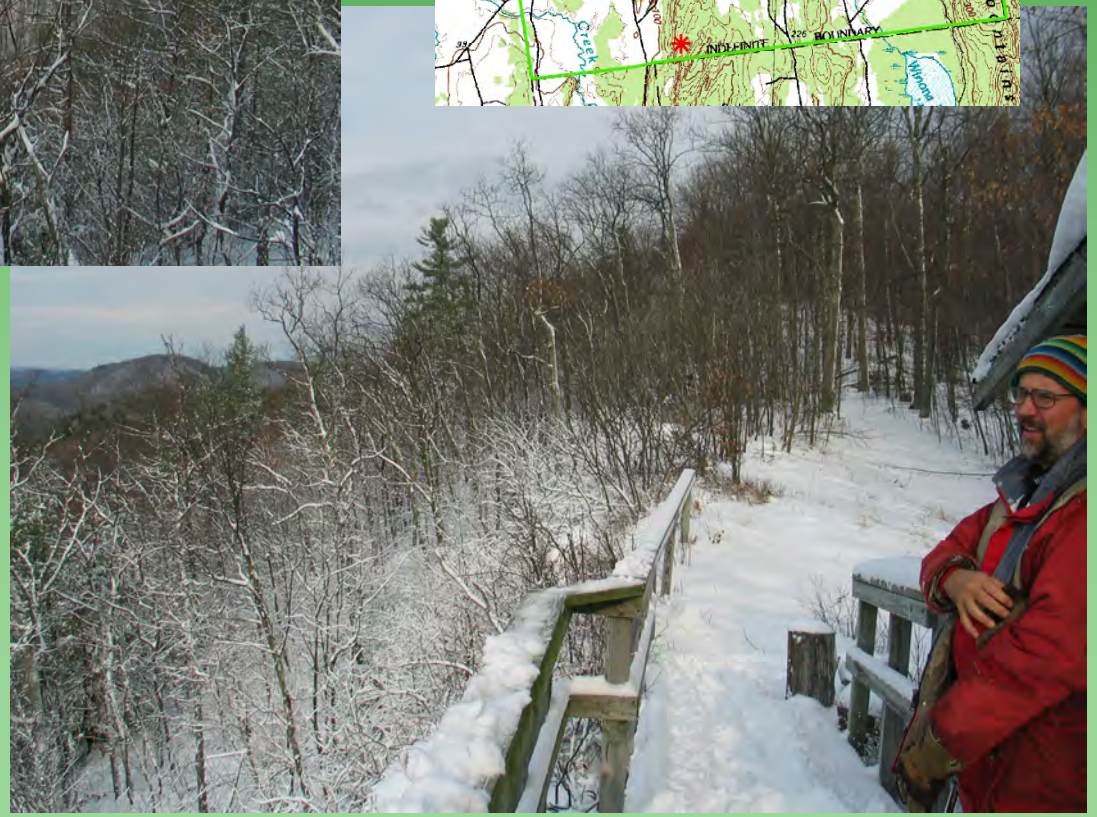
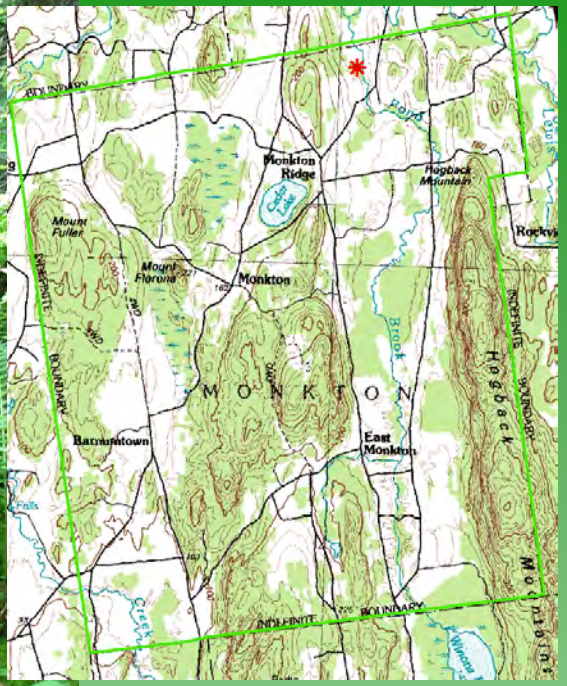
Hogback
Barnumtown
East Monkton
Falls
Creek
INDEFINITE
BOUNDARY

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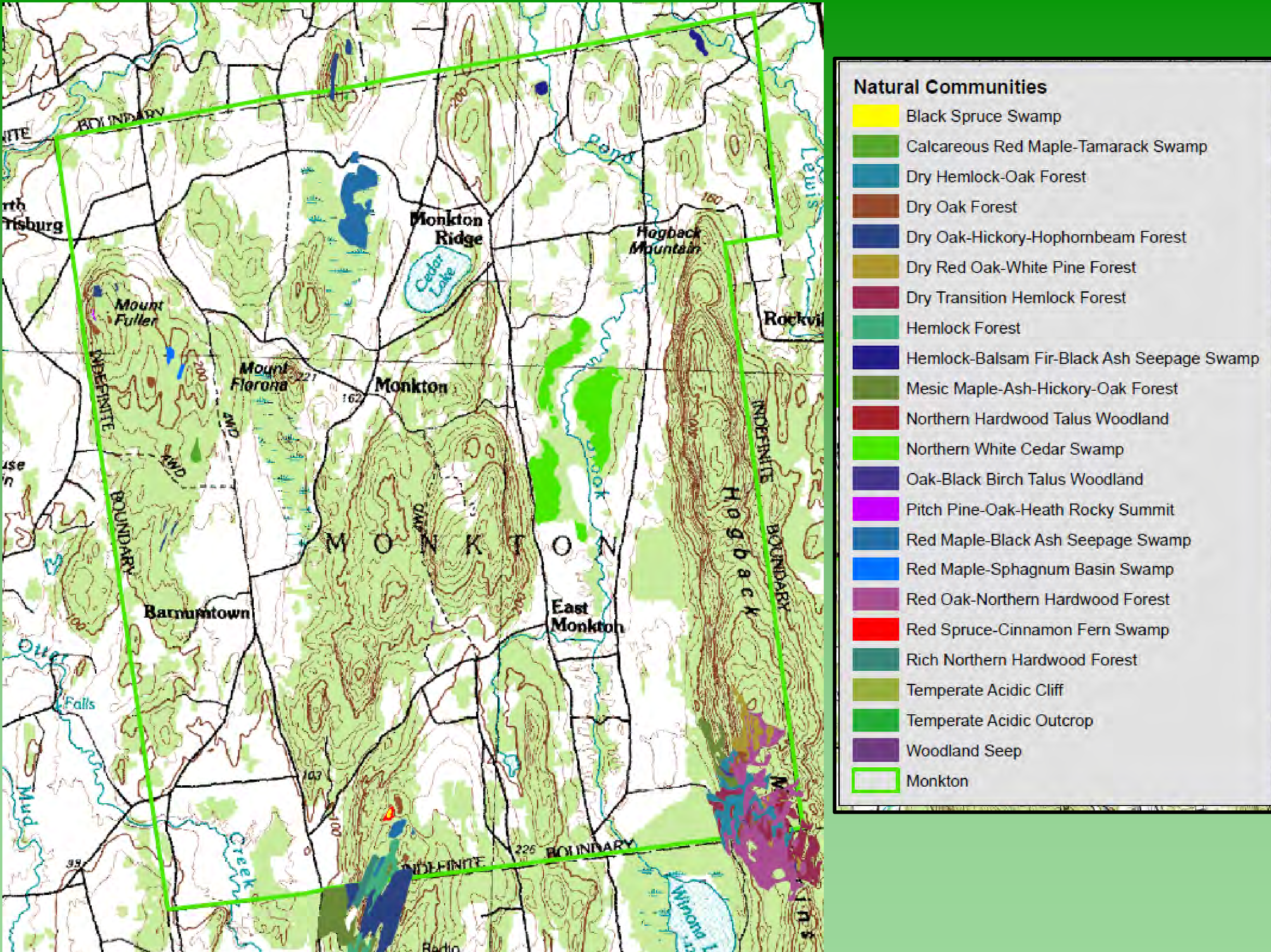

Natural Communities
Black Spruce Swamp
Calcareous Red Maple-Tamarack Swamp
Dry Hemlock-Oak Forest
Dry Oak Forest
Dry Oak-Hickory-Hophornbeam Forest
Dry Red Oak-White Pine Forest
Dry Transition Hemlock Forest
Hemlock Forest
Hemlock-Balsam Fir-Black Ash Seepage Swamp
Mesic Maple-Ash-Hickory-Oak Forest
Northern Hardwood Talus Woodland
Northern White Cedar Swamp
Oak-Black Birch Talus Woodland
Pitch Pine-Oak-Heath Rocky Summit
Red Maple-Black Ash Seepage Swamp
Red Maple-Sphagnum Basin Swamp
Red Oak-Northern Hardwood Forest
Red Spruce-Cinnamon Fern Swamp
Rich Northern Hardwood Forest
Temperate Acidic Cliff
Temperate Acidic Outcrop
Woodland Seep
Monkton
Monkton Ridge
Cedar Lake
Mount Fuller
Mount Florona
Monkton
M O N K T O N
Hogback Mountain
Hogback
East Monkton
Barnumtown
INDEFINITE BOUNDARY
Otter
Falls
Mud
Creek
Radio

Young and Old Forests

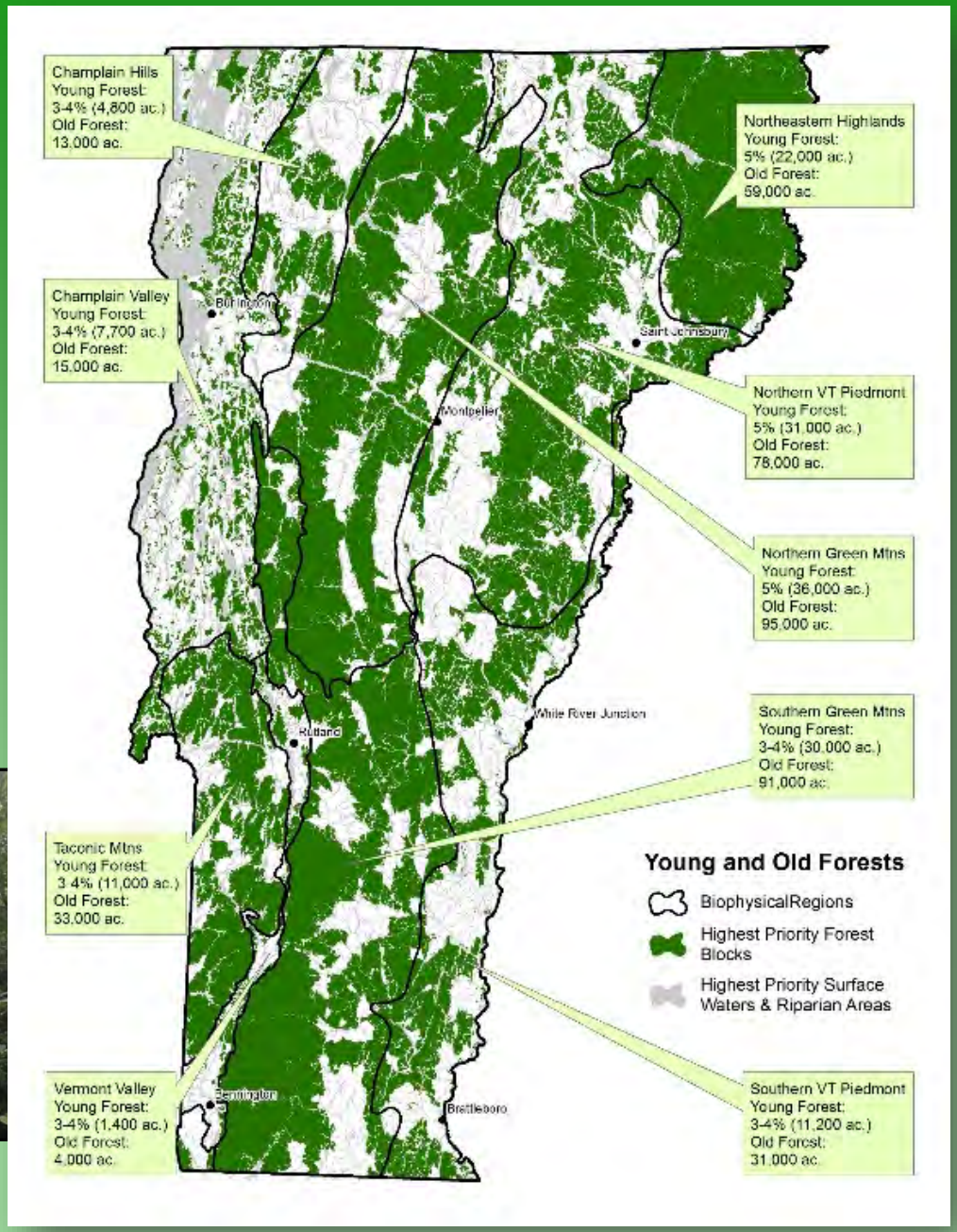
Young and old forests support a great diversity of species and ecological processes

Target of 3-5% young forest and 10% old forest, distributed across Vermont and proportional to matrix forest types

Ecological Functions:

- Young forests are habitat for many wildlife species, especially birds
- Old forests have complex and diverse habitats, contribute to clean air and water, and are particularly resilient to change

Balance!



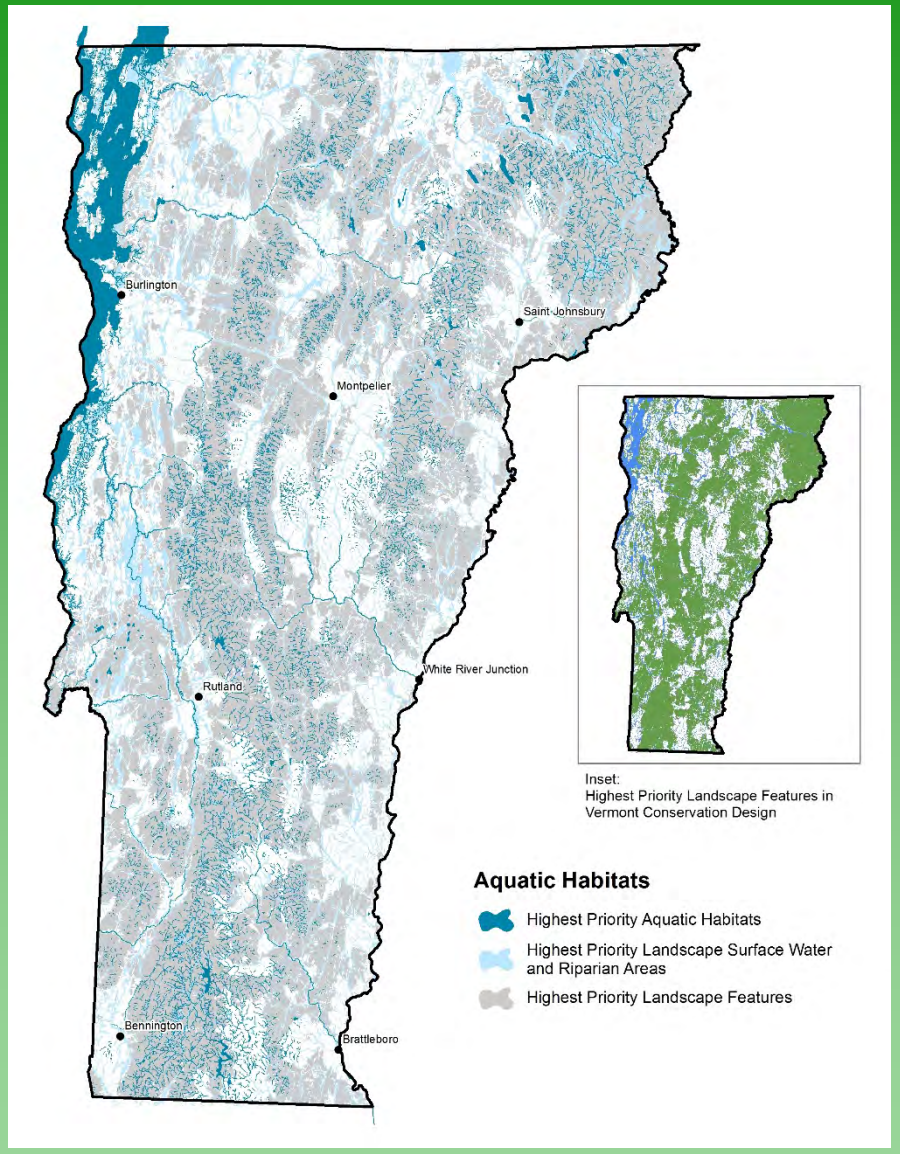
Aquatic Habitats

The river and stream segments, and lakes and ponds that make unique contributions to biological diversity

Need to be conserved as part of the larger network of surface waters and riparian areas

Ecological Functions:

- Habitat for rare and specialist species
- Physical diversity of aquatic systems
- Cold water refugia



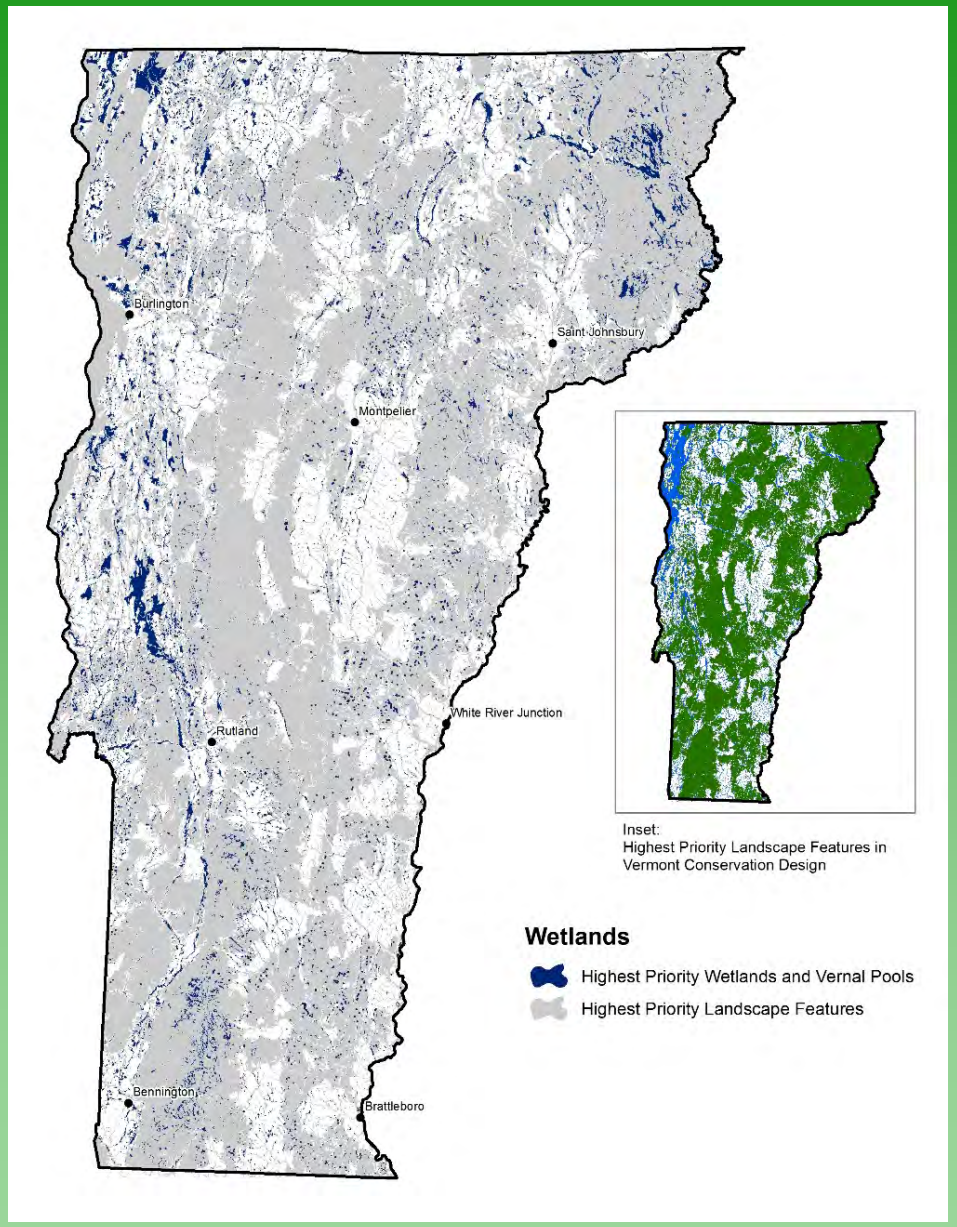
Wetlands

Vermont's wetlands provide irreplaceable habitats and ecological functions

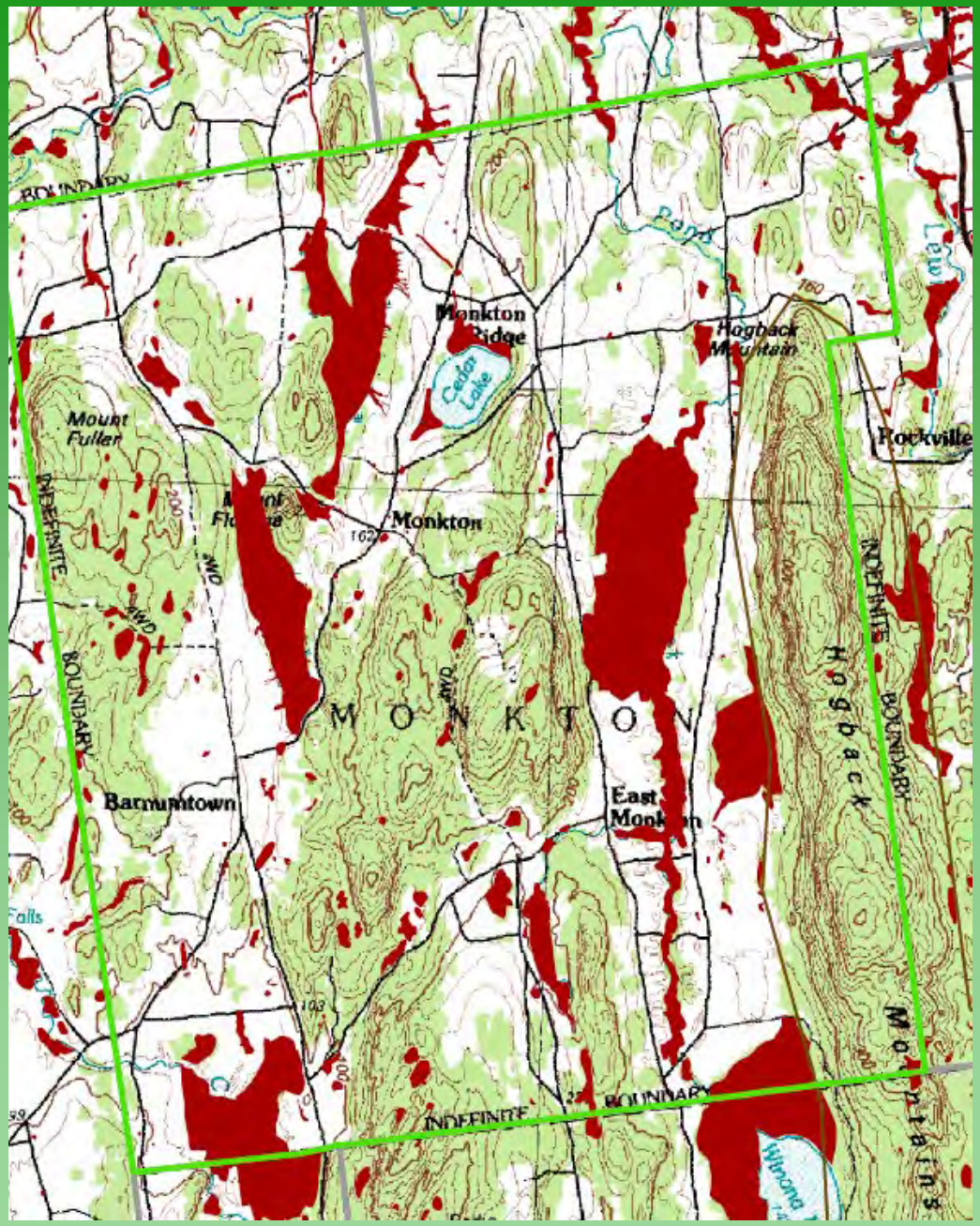
Almost all of Vermont's wetlands and vernal pools are highest priority

Ecological Functions:

- Fish and wildlife habitat
- Many rare species are found only in wetlands
- Flood protection
- Water quality
- Ground water protection



Monkton Wetlands



2,719 acres/23,211 acres = **11.8%**

Grasslands and Shrublands

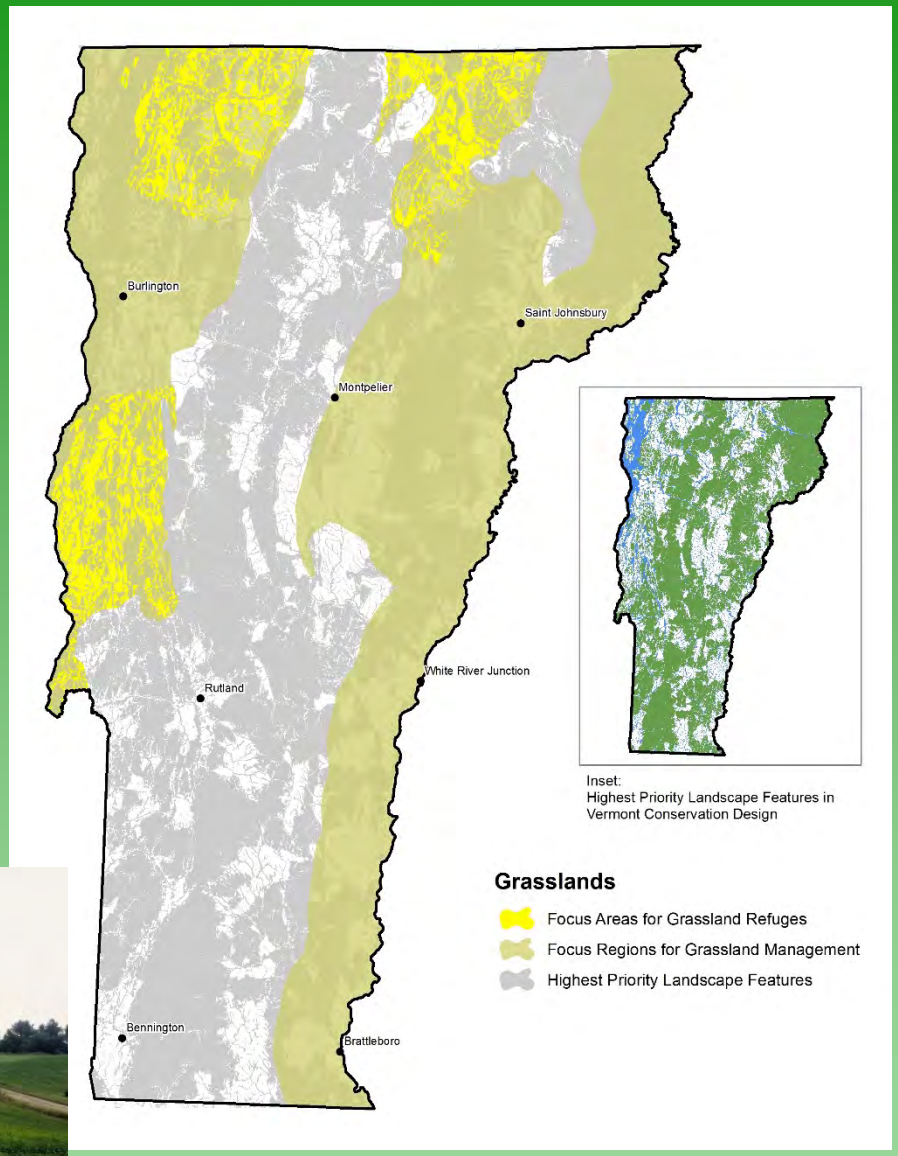
Grasslands and shrublands are man-made habitats that support a unique set of species

Many bird species that need grasslands or shrublands are in regional decline

"Lifeboat" of 7,500 acres to ensure these species remain in Vermont

Ecological Functions:

- Supports a suite of grassland-nesting and shrubland nesting birds
- Habitat that has been lost in other parts of the country



Underground Habitats

Caves and mines are our subterranean natural communities

We know much about the bats that use these places, but invertebrates, fungi, algae, and other species are likely present as well

A set of caves and mines, but not mapped so we can protect sensitive sites

Ecological Functions:

- Supports hibernating bats and likely many other species
- Habitat that has been lost in other parts of the country

Conservation Design at Three Scales

Landscapes

Interior Forest Blocks
Connectivity Blocks
Surface Waters and Riparian Areas
Riparian Areas for Connectivity
Physical Landscapes
Wildlife Road Crossings

Natural Communities

Natural Communities
Young and Old Forest
Aquatic Habitats
Wetlands
Grasslands/Shrublands
Underground Habitats

Species

Species with very specific biological needs that will likely always require individual attention

Northern pale painted cup
(*Castilleja septentrionalis*)

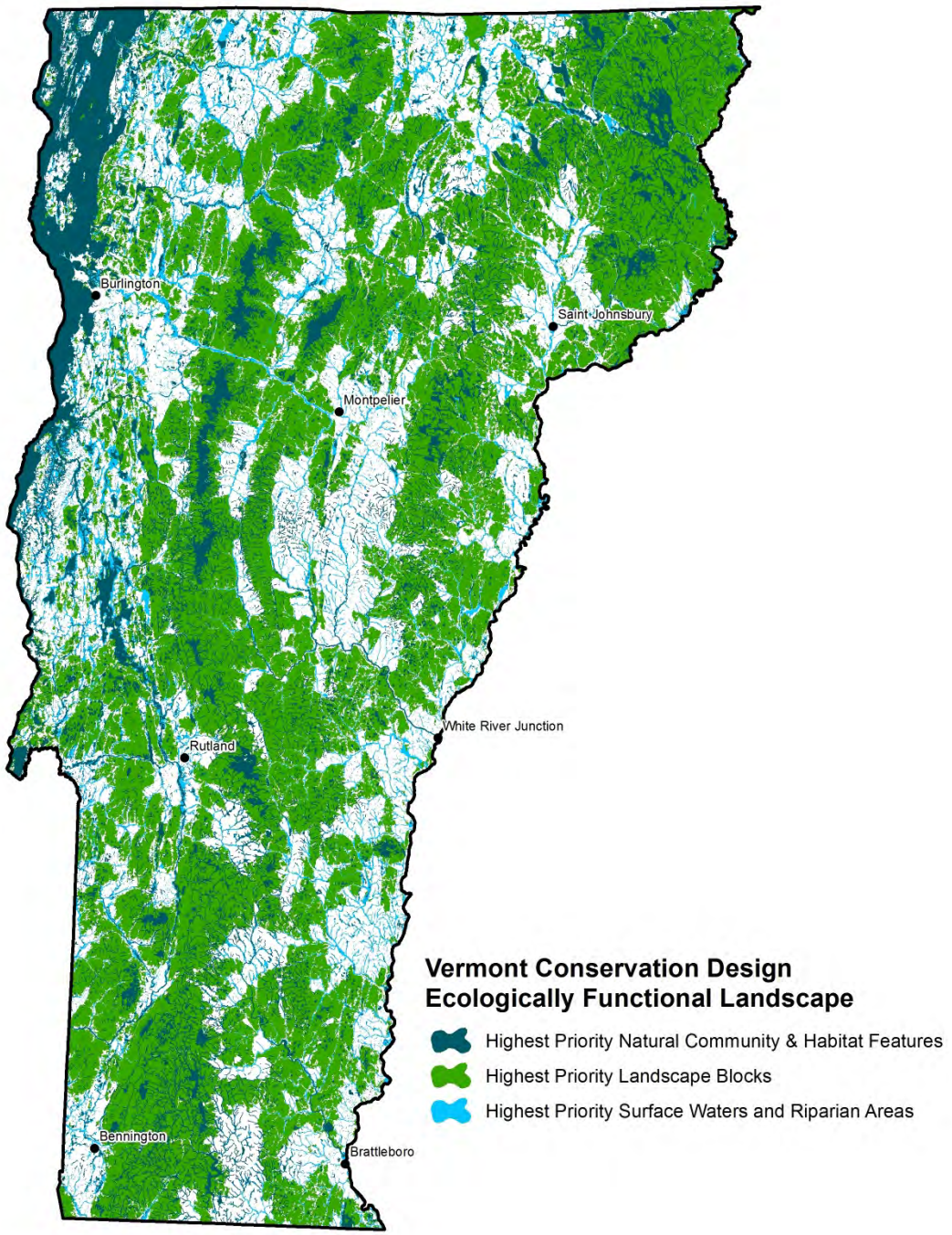
Spiny softshell turtle

Vermont Conservation Design

Maintains an intact, connected and diverse natural landscape

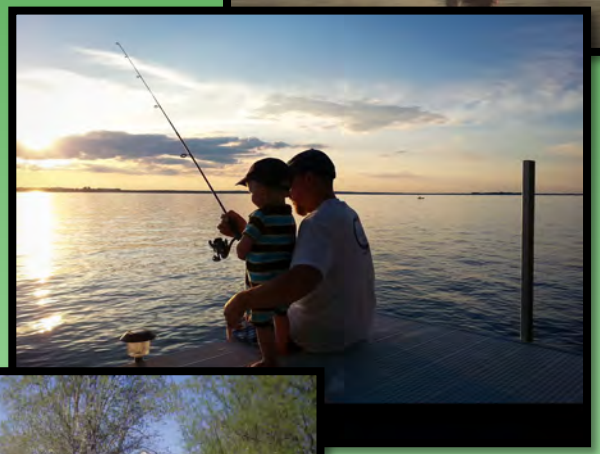
Conserves species and natural communities

Allows nature to adapt to a changing climate



Sustains more than biodiversity

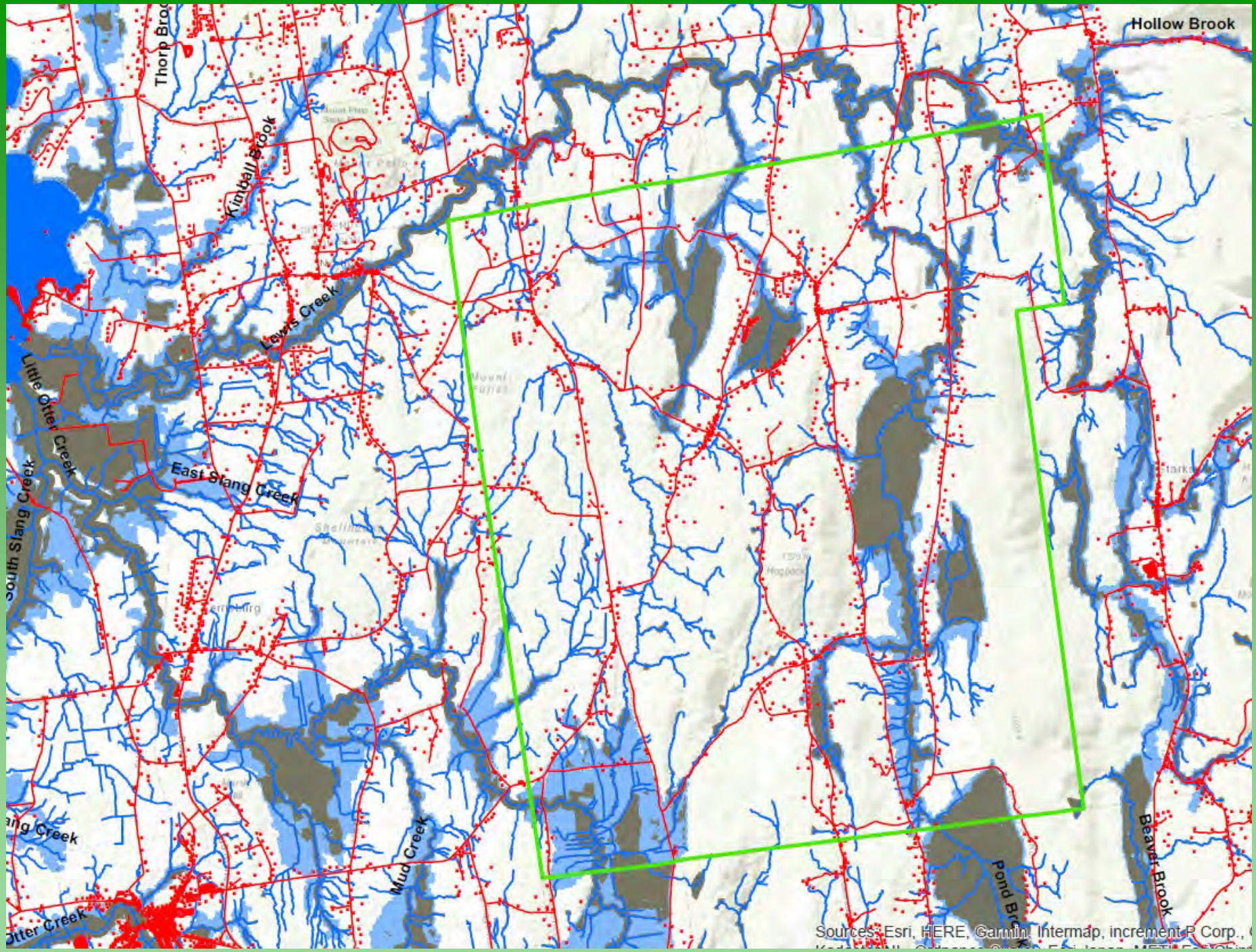
- Outdoor recreation
- Clean water
- Sense of place and rural character
- Working farms and forests
- Nature's benefits

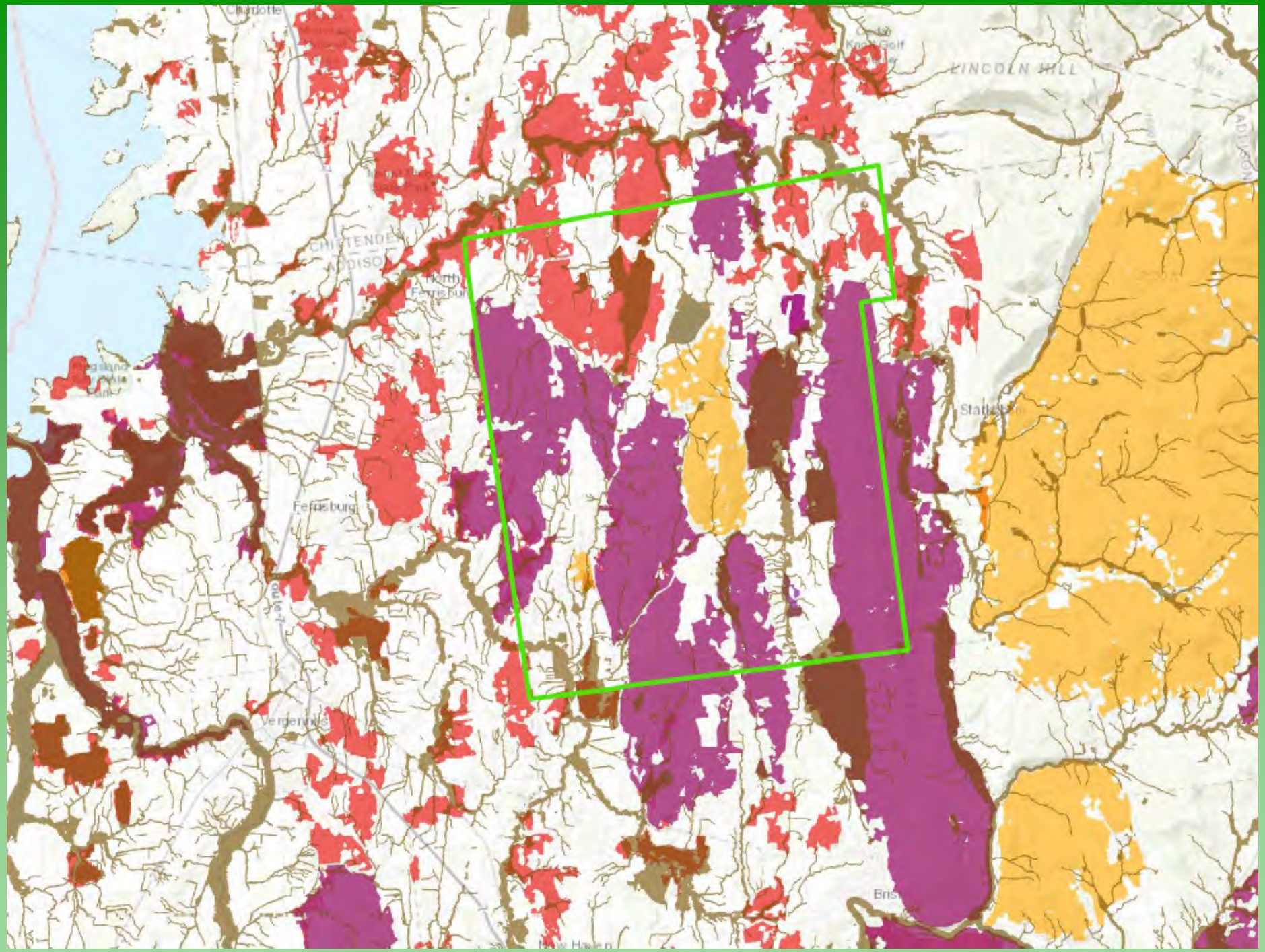


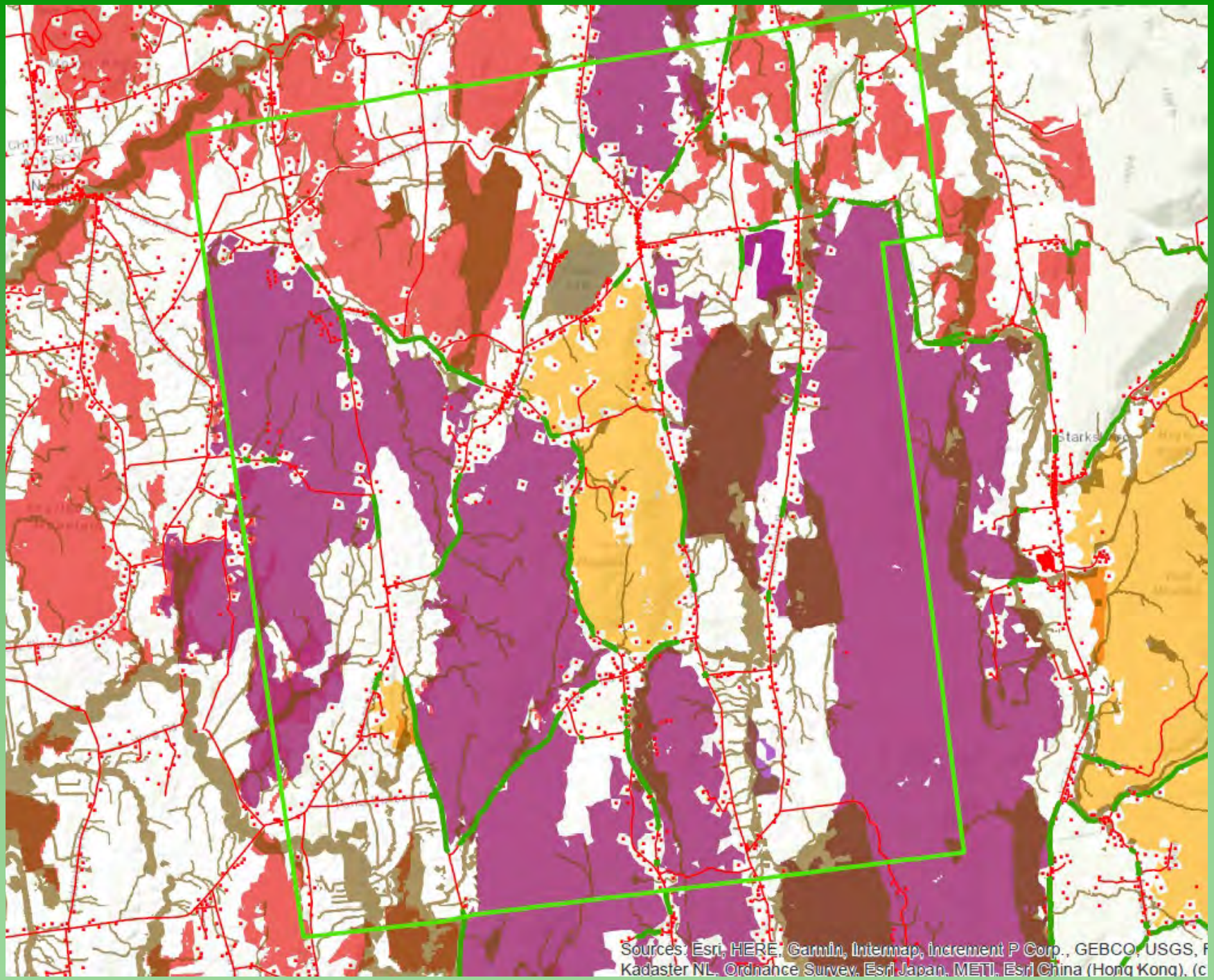
Some Thoughts and Perspectives

- Vision for the future of Vermont.
- Landowners and their decisions are key to success.
- All the features are needed for ecological function.
- Unifies many aspects of conservation, without being prescriptive.
- Supports Vermont's social and economic values.

Photo by Susan Morse


Hollow Brook
Thorp Brook
Kimball Brook
Lewis Creek
Little Otter Creek
East Stang Creek
South Stang Creek
Mud Creek
Pond Brook
Beaver Brook
Otter Creek
Sources: Esri, HERE, Garmin, Intermap, increment P Corp.,


Charlotte
LINCOLN HILL
CHITTENDEN
ADDISON
Ferrisburg
Vergennes
New Haven


Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS,
Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c

Monkton!

- Diversity of bedrock, soils, and topography
- Intersection of the Champlain Valley, Southern Green Mountains, and the looming Northern Green Mountains to the east
- Some of the most intact, large limy hills in the Champlain Valley
- Large forest blocks of all three types
- The rocky, durable and mostly intact Hogback Mountain, Little Hogback, Mount Fuller, and Hardscrabble Hills together provide connections out into the Champlain Valley
- Riparian corridors! Small streams and Pond Brook connecting to Lewis Creek and Otter Creek
- Many state-significant natural communities – much still to be explored

Thank you… Questions?