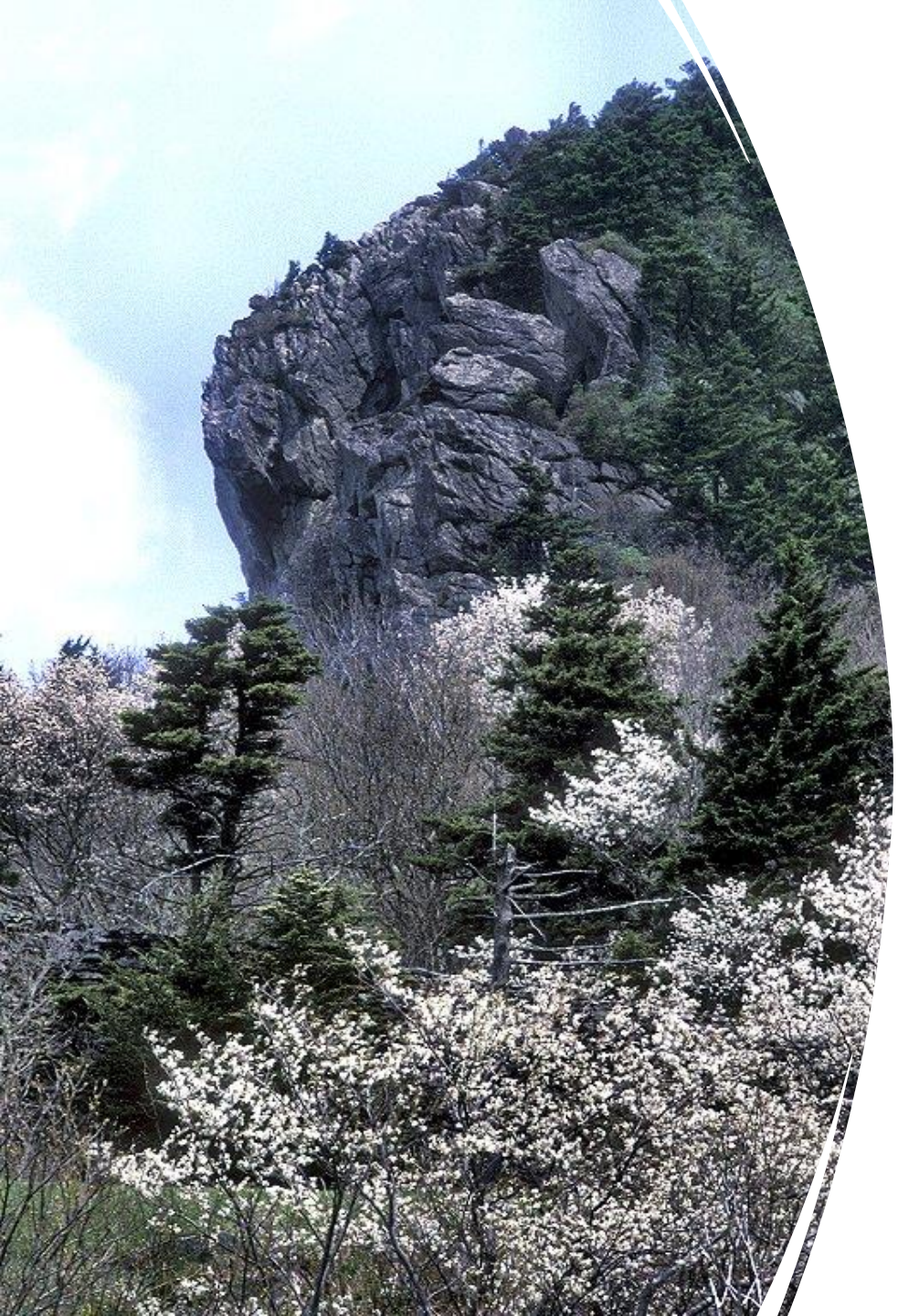
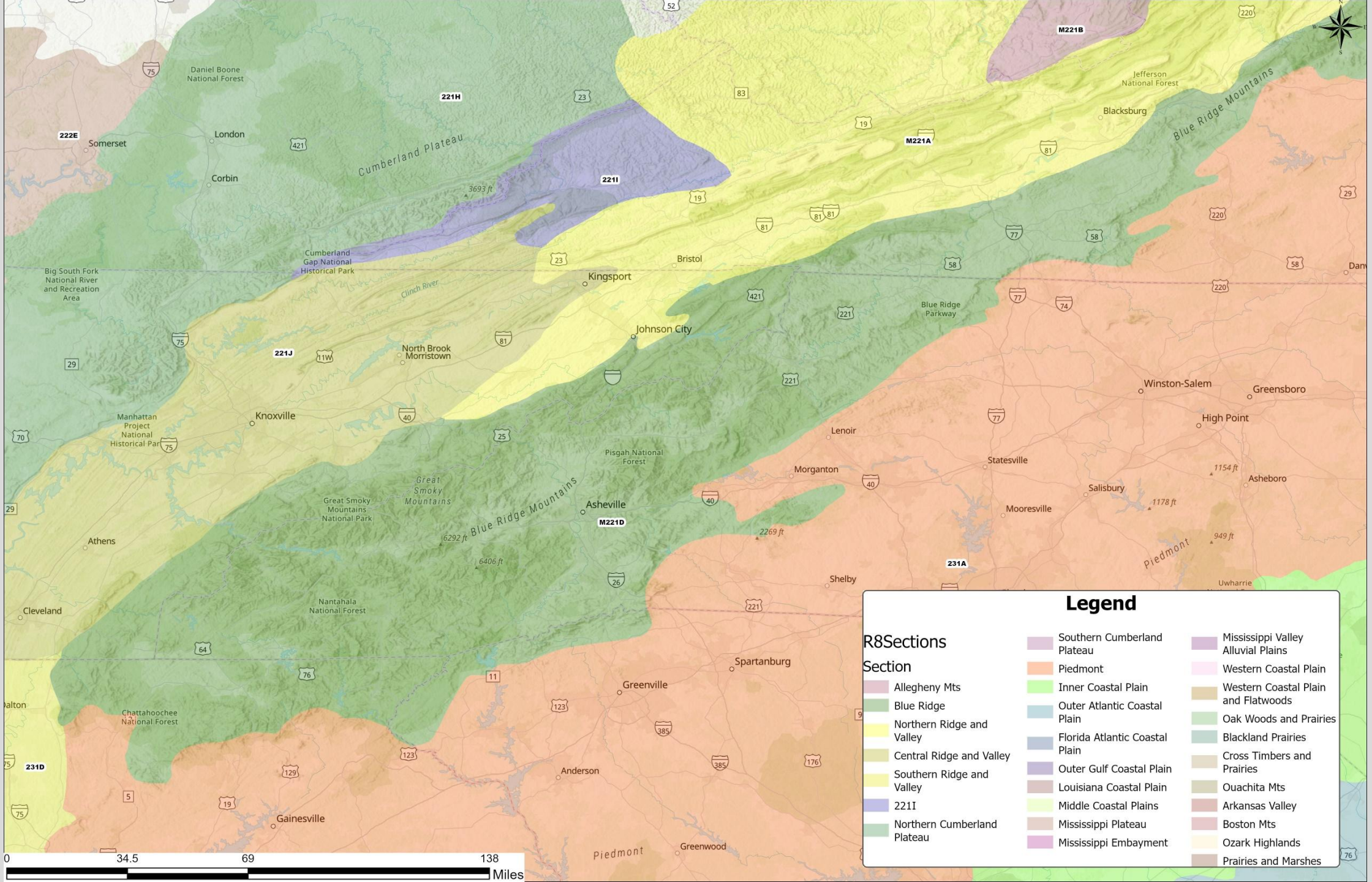
Rock Outcrop Communities in Western NC

Gary Kauffman
Retired
Botanist/Ecologist

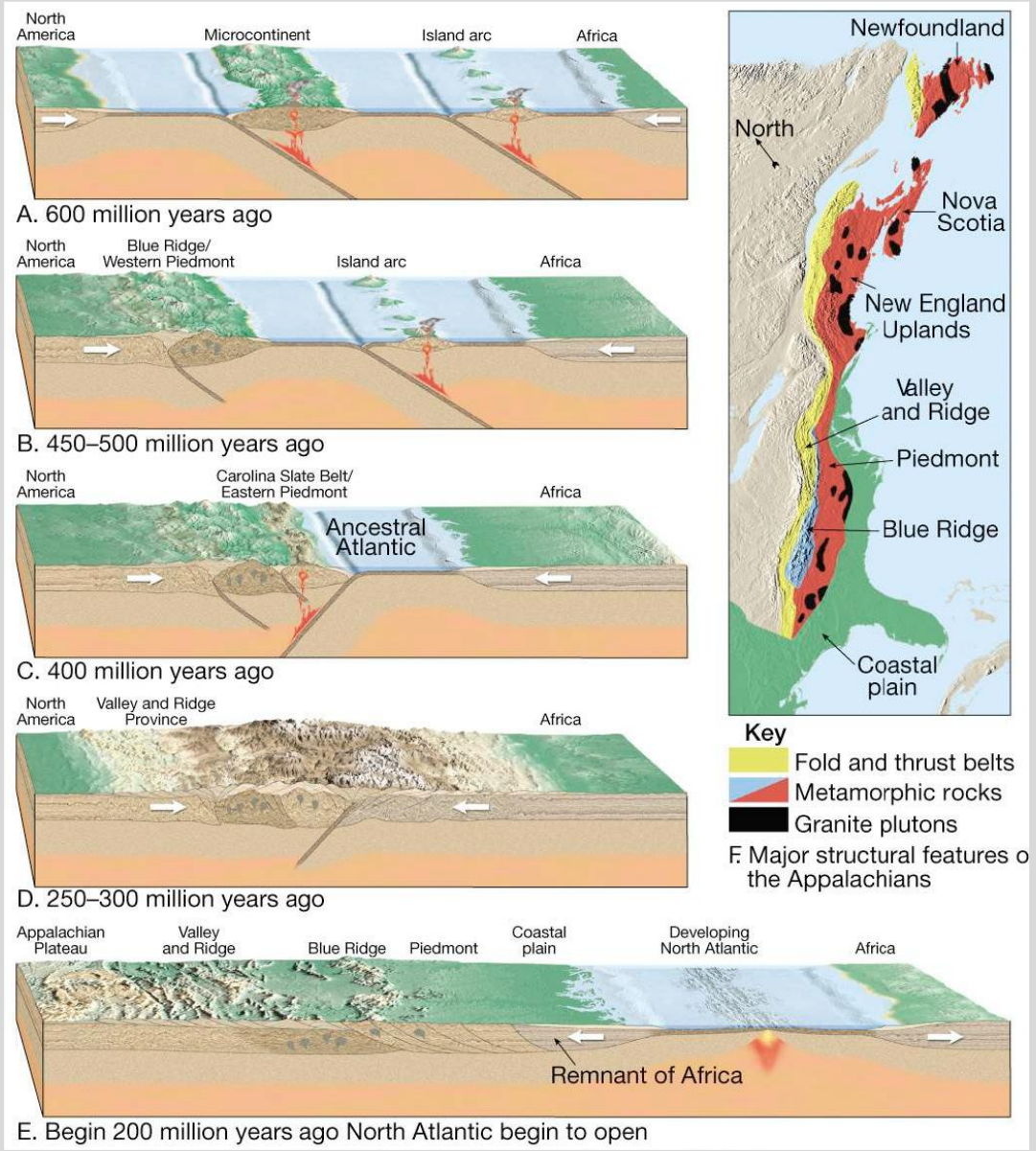


Discussion

- **Location/Context**
- **Plant Community Variation**
- **Associates**
- **Disturbance Regime**
- **Threats/Stressors**


Legend
R8Sections
Section
Allegheny Mts
Blue Ridge
Northern Ridge and Valley
Central Ridge and Valley
Southern Ridge and Valley
221I
Northern Cumberland Plateau
Southern Cumberland Plateau
Piedmont
Inner Coastal Plain
Outer Atlantic Coastal Plain
Florida Atlantic Coastal Plain
Outer Gulf Coastal Plain
Louisiana Coastal Plain
Middle Coastal Plains
Mississippi Plateau
Mississippi Embayment
Mississippi Valley Alluvial Plains
Western Coastal Plain
Western Coastal Plain and Flatwoods
Oak Woods and Prairies
Blackland Prairies
Cross Timbers and Prairies
Ouachita Mts
Arkansas Valley
Boston Mts
Ozark Highlands
Prairies and Marshes
0
34.5
69
138
Miles
Cumberland Plateau
Blue Ridge Mountains
Piedmont
Great Smoky Mountains
Daniel Boone National Forest
Jefferson National Forest
Cumberland Gap National Historical Park
Big South Fork National River and Recreation Area
Blue Ridge Parkway
Pisgah National Forest
Nantahala National Forest
Chattahoochee National Forest
Great Smoky Mountains National Park
Manhattan Project National Historical Park
Somerset
London
Corbin
Kingsport
Bristol
Johnson City
North Brook
Morristown
Knoxville
Asheville
Blacksburg
Winston-Salem
Greensboro
High Point
Lenoir
Morganton
Statesville
Salisburg
Asheboro
Mooresville
Shelby
Spartanburg
Greenville
Anderson
Gainesville
Greenwood
Athens
Cleveland
221H
221I
221J
222E
231A
231D
M221A
M221B
M221D
3693 ft
6292 ft
6406 ft
2269 ft
1178 ft
1154 ft
949 ft

The mountains were built by a *series* of orogenies in the Paleozoic Era – incorporating volcanic rocks, marine sediment, and the basalt floor of the ancient ocean.



Dr. Shane Schoepfer

As a result, our rocks here in the Blue Ridge are predominantly metamorphic *gneisses*

The abundance of minerals containing Aluminum tells us that these metamorphic rocks are ultimately derived from clay-rich marine sediments.

Dr. Shane Schoepfer

Types of Rocks

Metamorphic Rocks

Formed when existing rocks are transformed by heat and pressure.

Foliated:
Have a layered or banded appearance due to alignment of minerals

Gneiss Slate

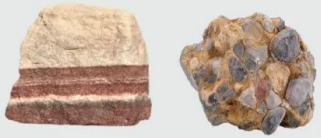
Non-foliated do not have layers.

Marble Hornfels

Sedimentary Rocks

Created from the accumulation and compaction of sediments over time.

Clastic:
Made from fragments of other rock

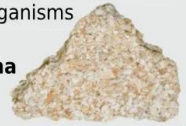


Sandstone Conglomerate

Chemical:
Formed when minerals precipitate from a solution via chemical processes.

Limestone Gypsum

Organic:
Composed of organic material from the remains of organisms



Coquina

Igneous Rocks

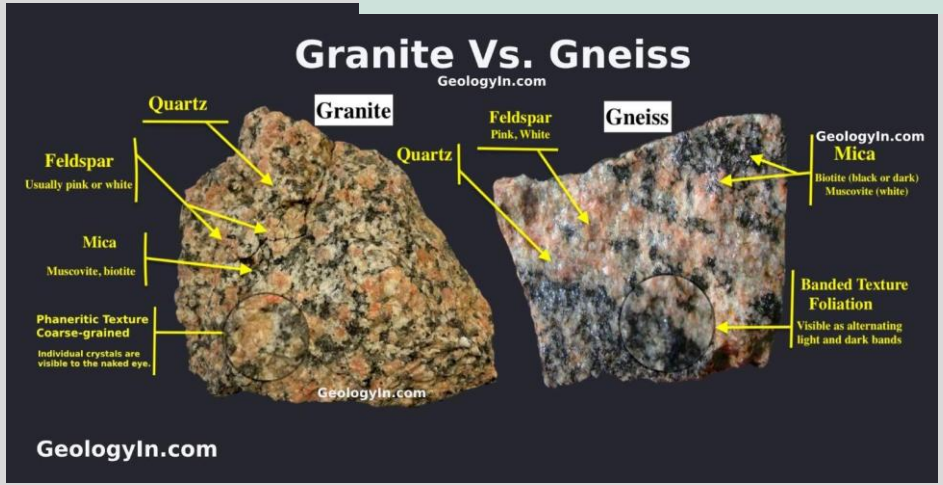
Formed from cooling magma or lava

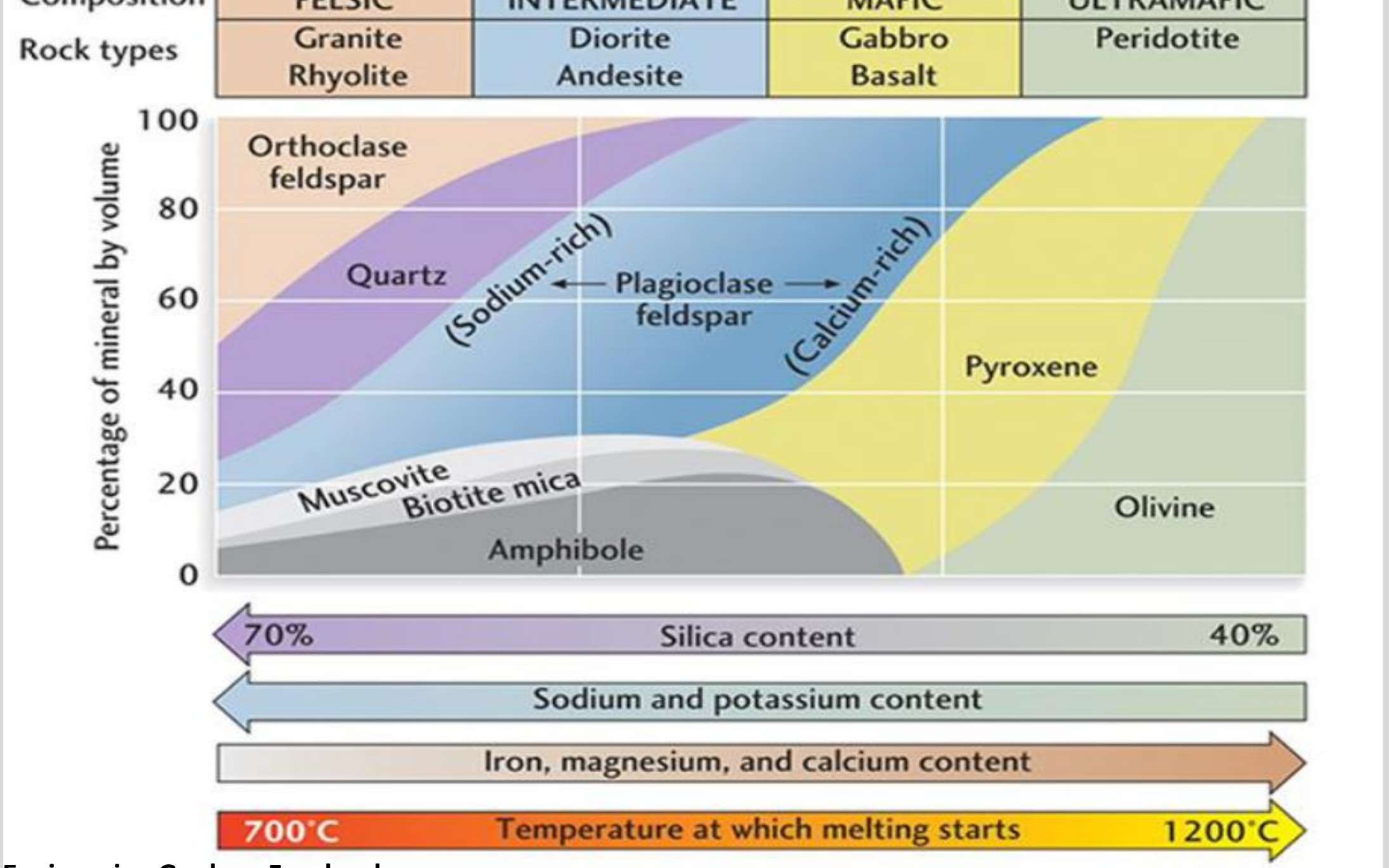
Intrusive (Plutonic):
Form when magma cools slowly beneath the Earth's surface

Granite Gabbro

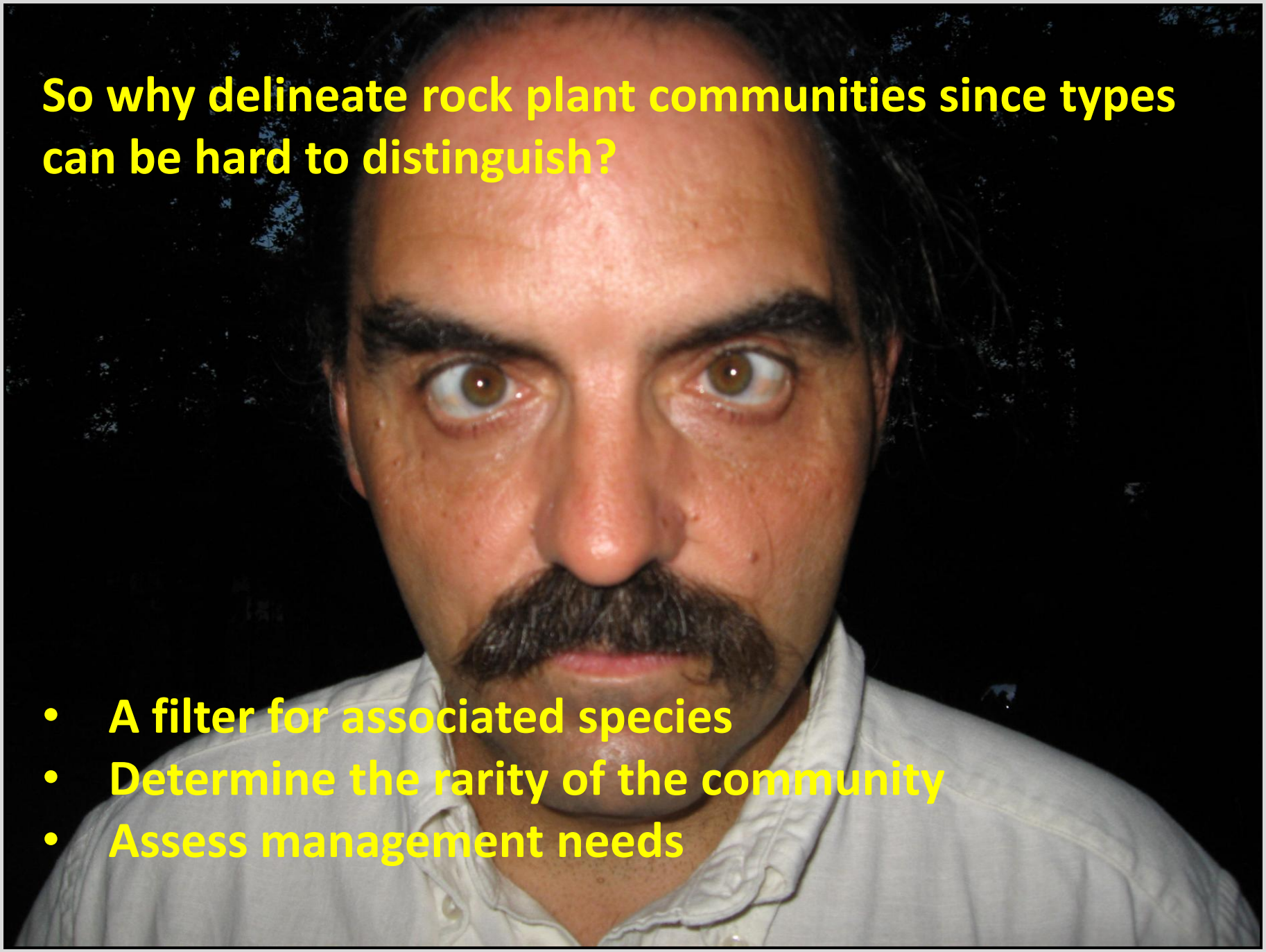
Extrusive (Volcanic):
Formed from lava that cools quickly on the Earth's surface.

Rhyolite Basalt Obsidian

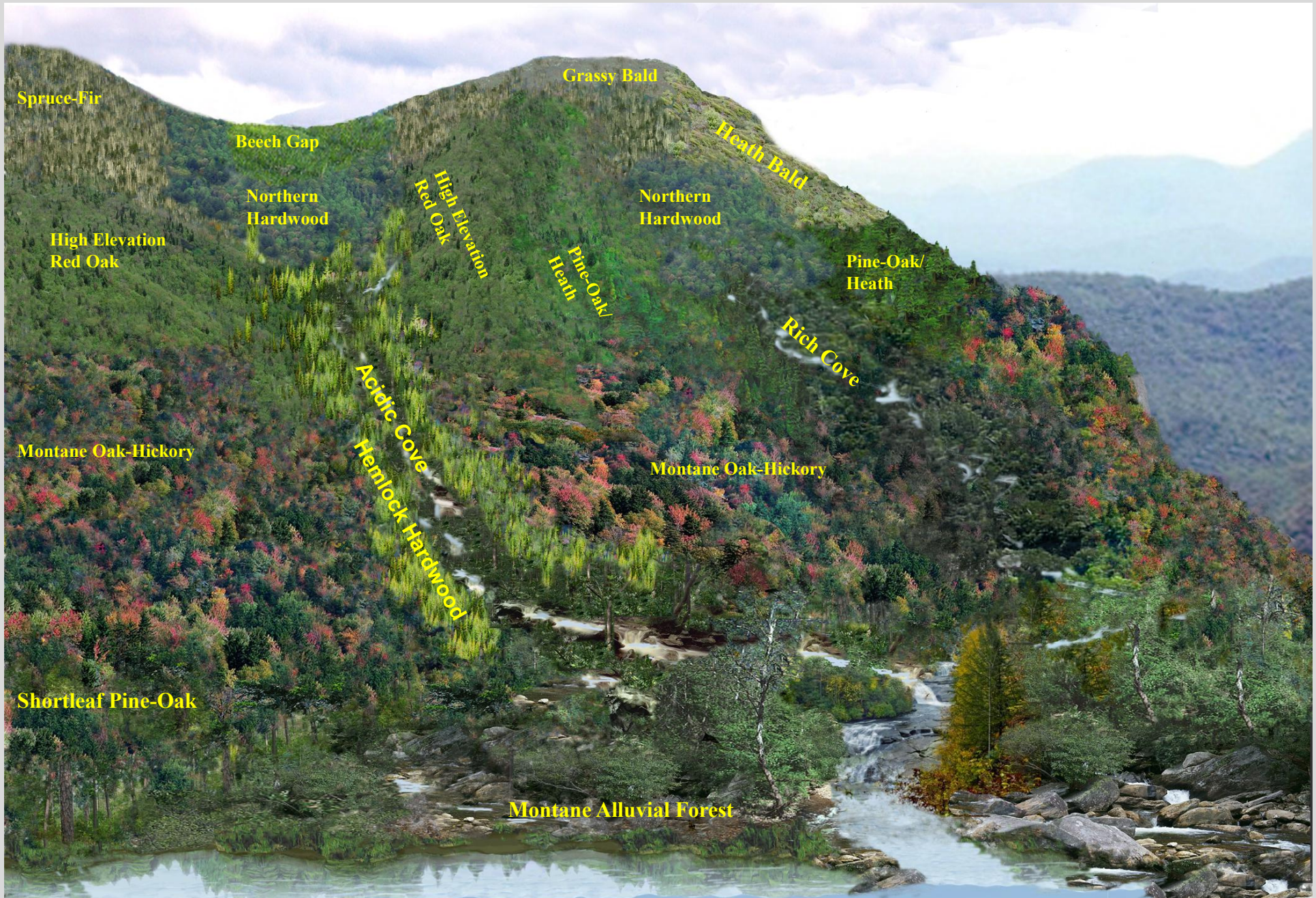


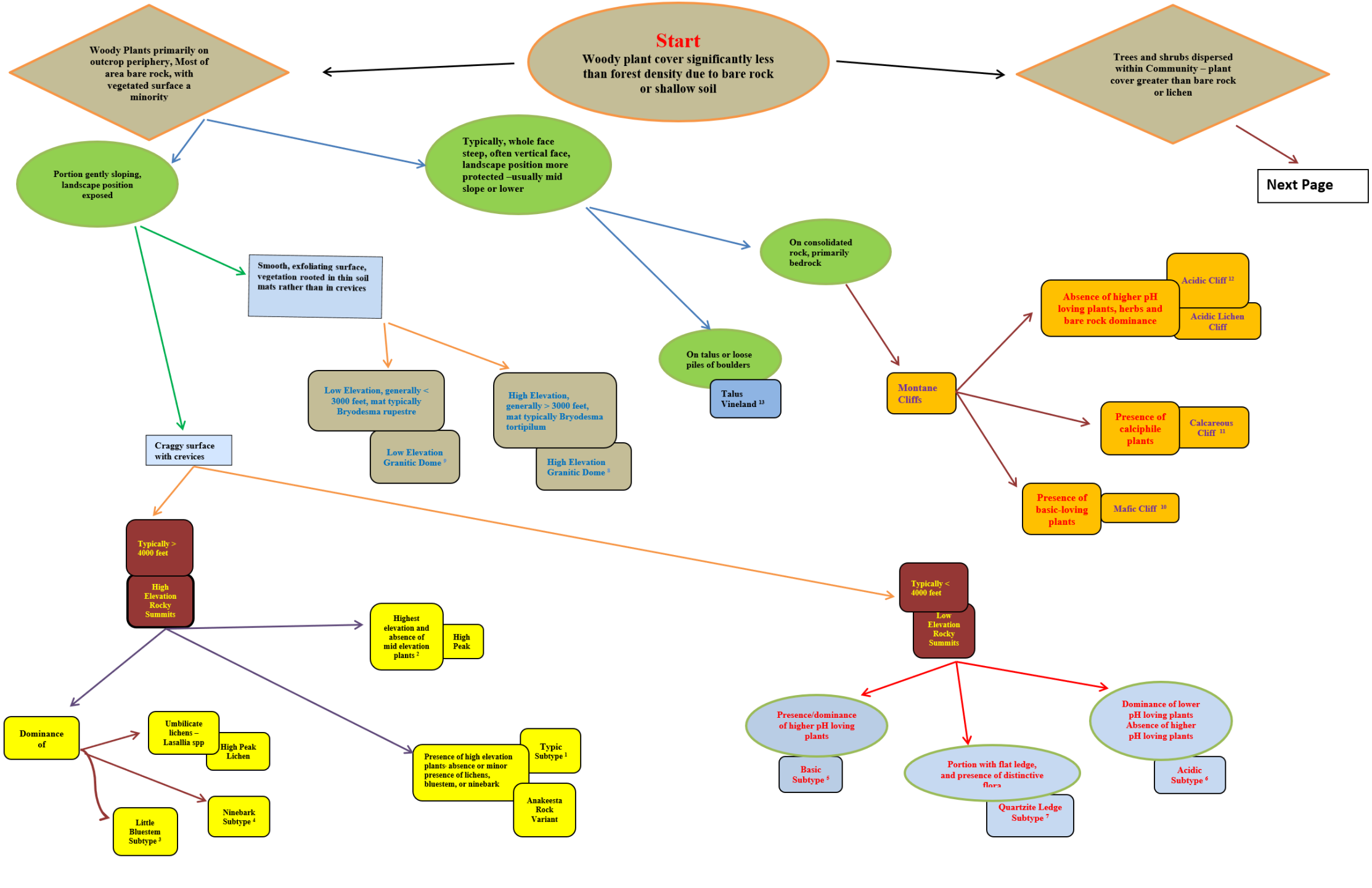


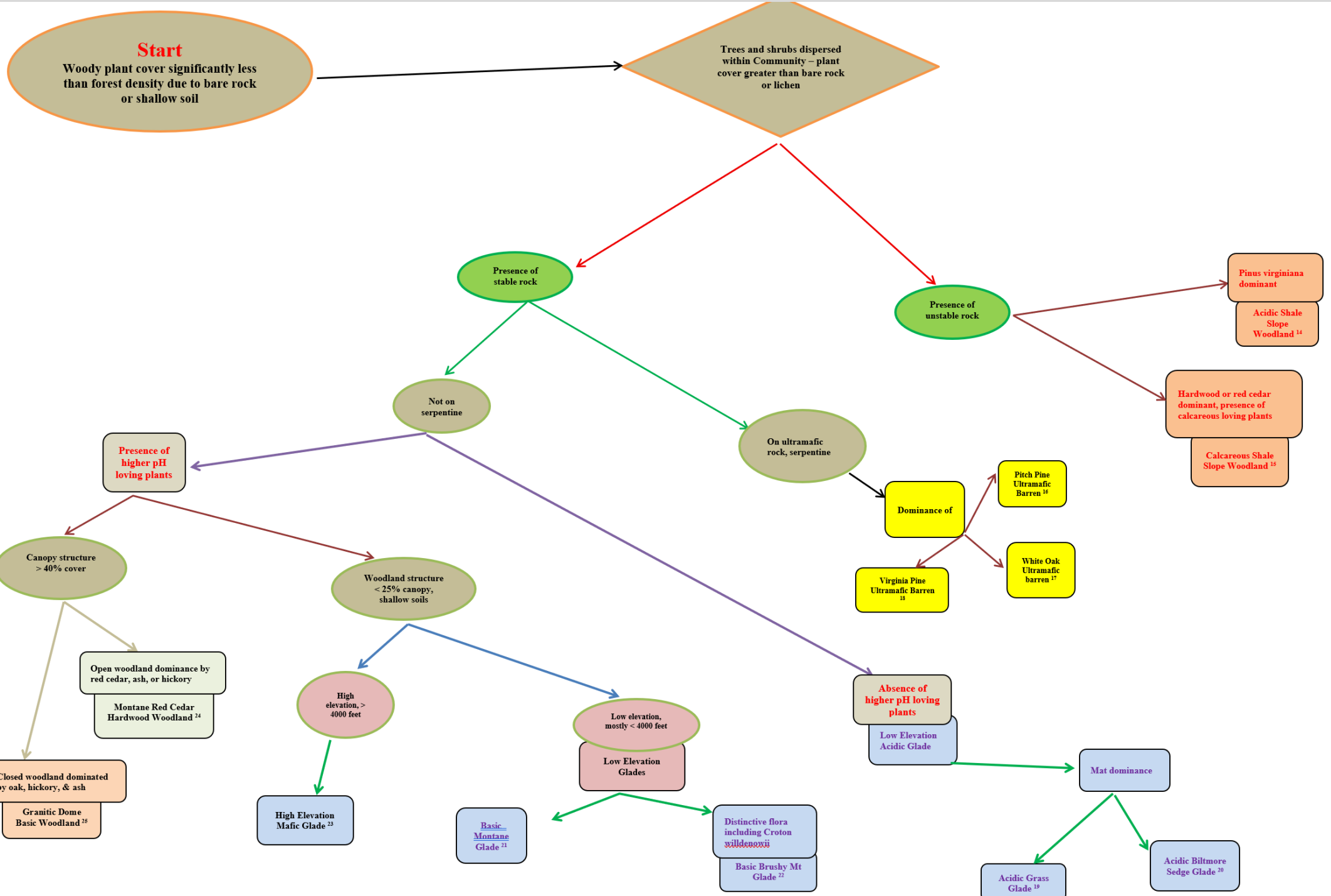
Engineering Geology Facebook


So why delineate rock plant communities since types can be hard to distinguish?
• A filter for associated species
• Determine the rarity of the community
• Assess management needs

Plant Communities in Landscape



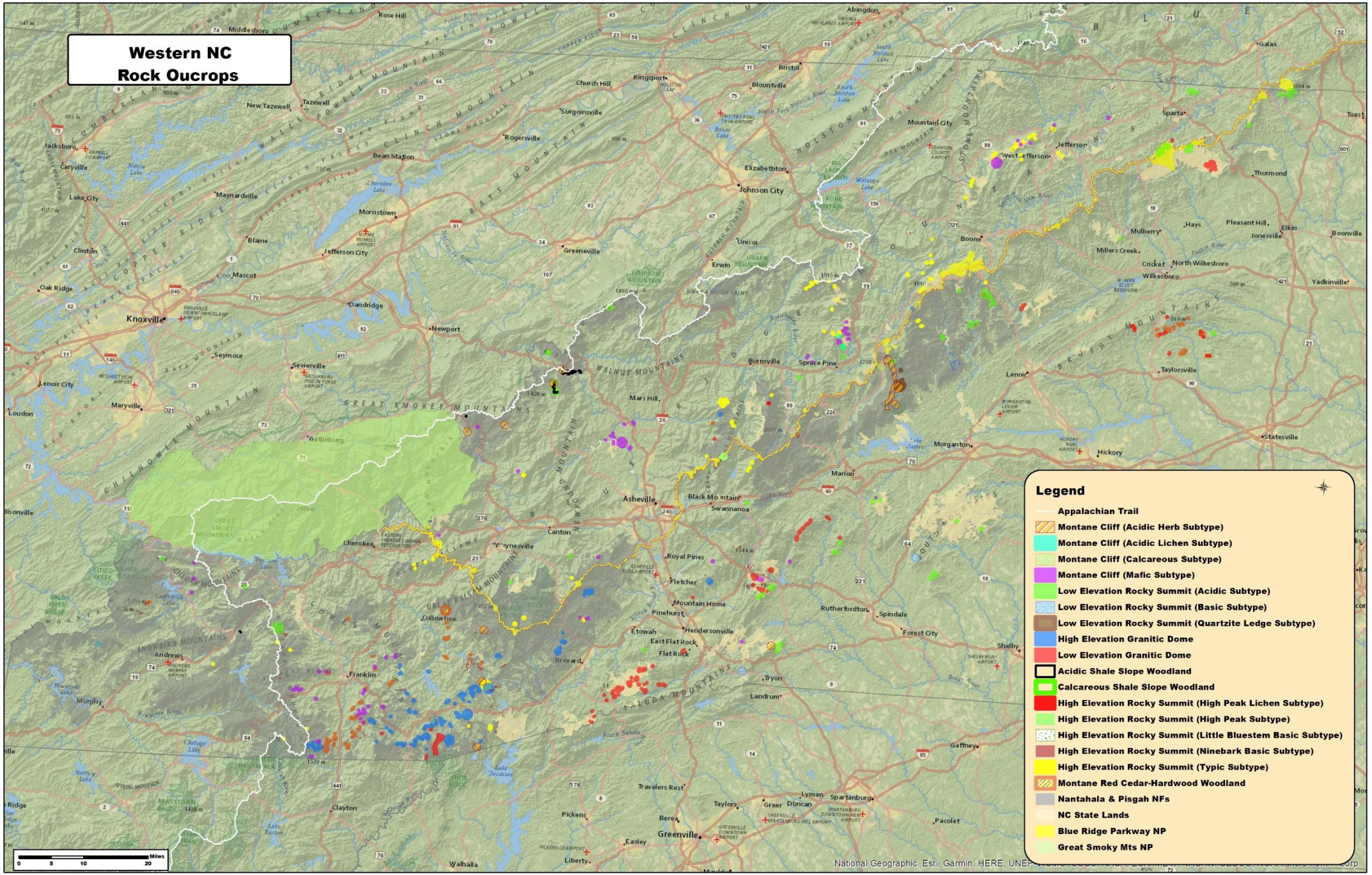

Start
Woody plant cover significantly less than forest density due to bare rock or shallow soil
Woody Plants primarily on outcrop periphery, Most of area bare rock, with vegetated surface a minority
Trees and shrubs dispersed within Community – plant cover greater than bare rock or lichen
Next Page
Portion gently sloping, landscape position exposed
Typically, whole face steep, often vertical face, landscape position more protected –usually mid slope or lower
Smooth, exfoliating surface, vegetation rooted in thin soil mats rather than in crevices
Craggy surface with crevices
On consolidated rock, primarily bedrock
On talus or loose piles of boulders
Talus Vineland 13
Low Elevation, generally < 3000 feet, mat typically Bryodesma rupestre
Low Elevation Granitic Dome 9
High Elevation, generally > 3000 feet, mat typically Bryodesma tortipilum
High Elevation Granitic Dome 8
Montane Cliffs
Absence of higher pH loving plants, herbs and bare rock dominance
Acidic Cliff 12
Acidic Lichen Cliff
Presence of calciphile plants
Calcareous Cliff 11
Presence of basic-loving plants
Mafic Cliff 10
Typically > 4000 feet
High Elevation Rocky Summits
Highest elevation and absence of mid elevation plants 2
High Peak
Dominance of
Umbilicate lichens – Lasallia spp
High Peak Lichen
Little Bluestem Subtype 3
Ninebark Subtype 4
Presence of high elevation plants- absence or minor presence of lichens, bluestem, or ninebark
Typic Subtype 1
Anakeesta Rock Variant
Typically < 4000 feet
Low Elevation Rocky Summits
Presence/dominance of higher pH loving plants
Basic Subtype 5
Portion with flat ledge, and presence of distinctive flora
Quartzite Ledge Subtype 7
Dominance of lower pH loving plants Absence of higher pH loving plants
Acidic Subtype 6


Start
Woody plant cover significantly less than forest density due to bare rock or shallow soil
Trees and shrubs dispersed within Community – plant cover greater than bare rock or lichen
Presence of stable rock
Presence of unstable rock
Pinus virginiana dominant
Acidic Shale Slope Woodland 14
Hardwood or red cedar dominant, presence of calcareous loving plants
Calcareous Shale Slope Woodland 15
Not on serpentine
On ultramafic rock, serpentine
Dominance of
Pitch Pine Ultramafic Barren 16
White Oak Ultramafic barren 17
Virginia Pine Ultramafic Barren 18
Presence of higher pH loving plants
Canopy structure > 40% cover
Woodland structure < 25% canopy, shallow soils
Open woodland dominance by red cedar, ash, or hickory
Montane Red Cedar Hardwood Woodland 24
Closed woodland dominated by oak, hickory, & ash
Granitic Dome Basic Woodland 25
High elevation, > 4000 feet
Low elevation, mostly < 4000 feet
High Elevation Mafic Glade 23
Low Elevation Glades
Basic Montane Glade 21
Distinctive flora including Croton willdenowii
Basic Brushy Mt Glade 22
Absence of higher pH loving plants
Low Elevation Acidic Glade
Mat dominance
Acidic Grass Glade 19
Acidic Biltmore Sedge Glade 20

Simplified Rock Outcrop Communities

- Bare Rock Prominent
  - High Elevation Rocky Summit
  - Low Elevation Rocky Summit
  - High Elevation Granitic Dome
  - Low Elevation Granitic Dome
  - Montane Cliff
  - Talus Vineland

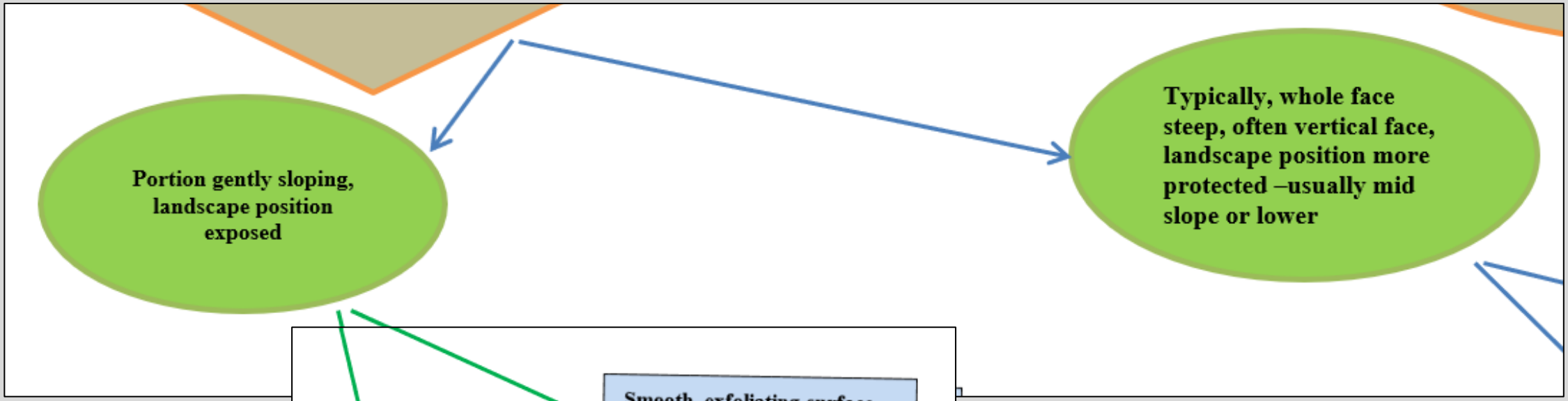
- Plant cover greater than bare rock
  - Shale Slope
  - High Elevation Mafic Glade
  - Low Elevation Glade
  - Montane Red Cedar Hardwood Woodland
  - Granitic Dome Basic Woodland
  - Ulramafic Barren

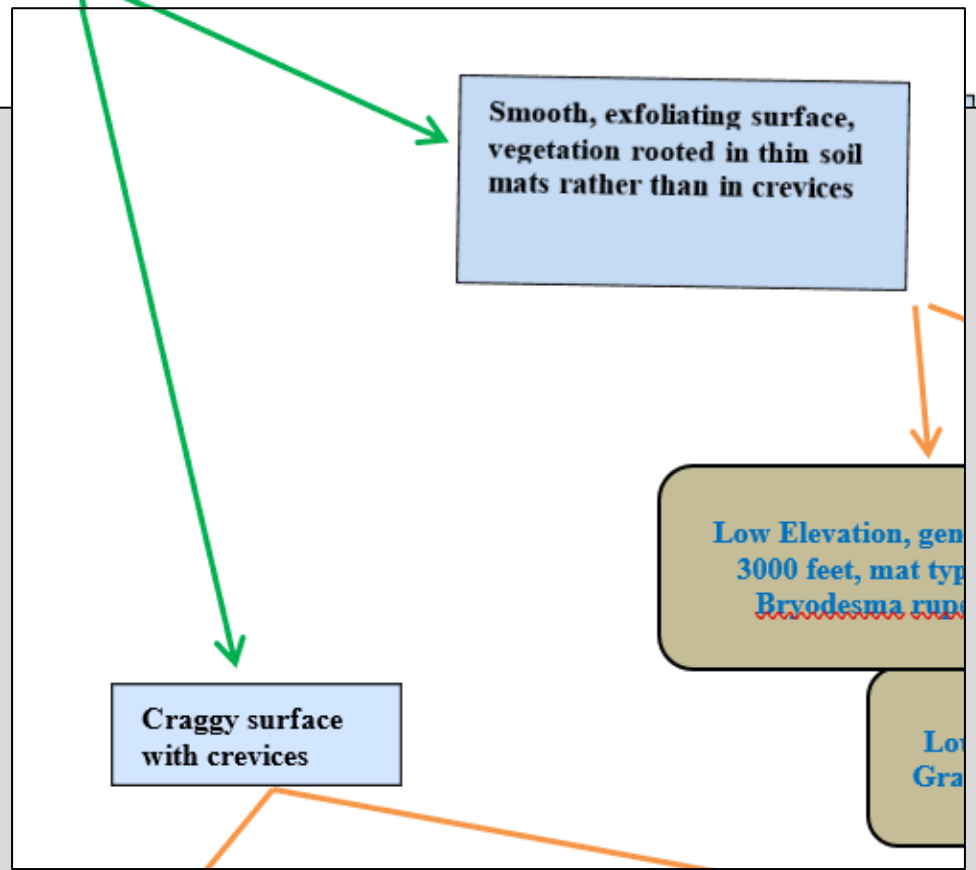


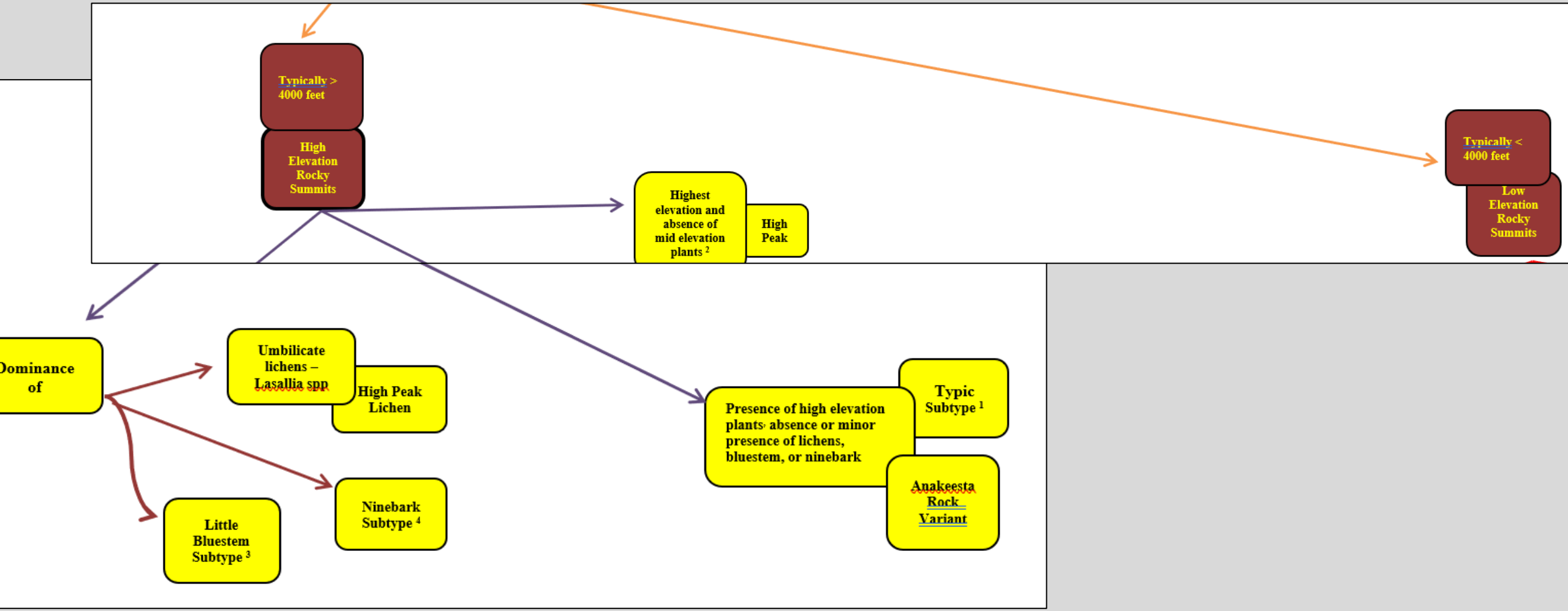
Dispersed throughout

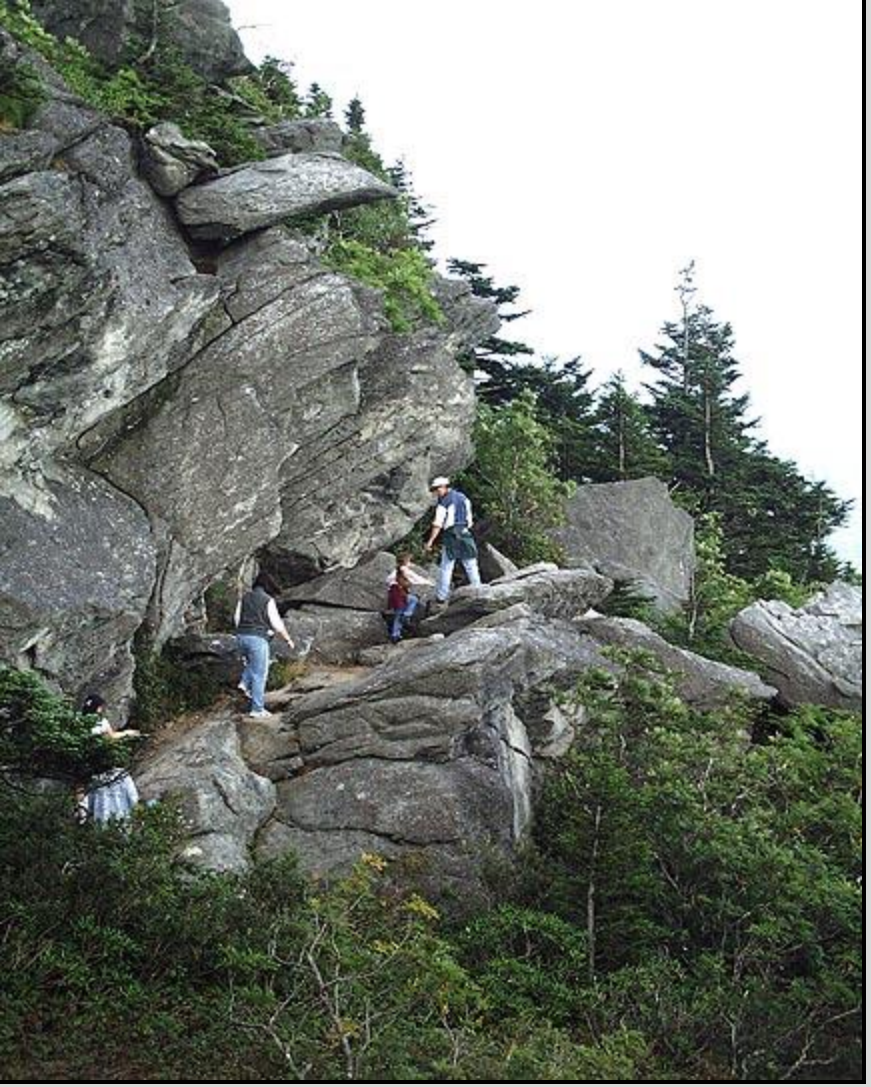
Variation based on elevation, structure, geology and plant dominance

High Elevation Rocky Summits Flow Chart






Typically > 4000 feet
High Elevation Rocky Summits
Highest elevation and absence of mid elevation plants [2]
High Peak
Typically < 4000 feet
Low Elevation Rocky Summits
Dominance of
Umbilicate lichens – Lasallia spp
High Peak Lichen
Ninebark Subtype [4]
Little Bluestem Subtype [3]
Presence of high elevation plants, absence or minor presence of lichens, bluestem, or ninebark
Typic Subtype [1]
Anakeesta Rock Variant



High Elevation Rocky Summit

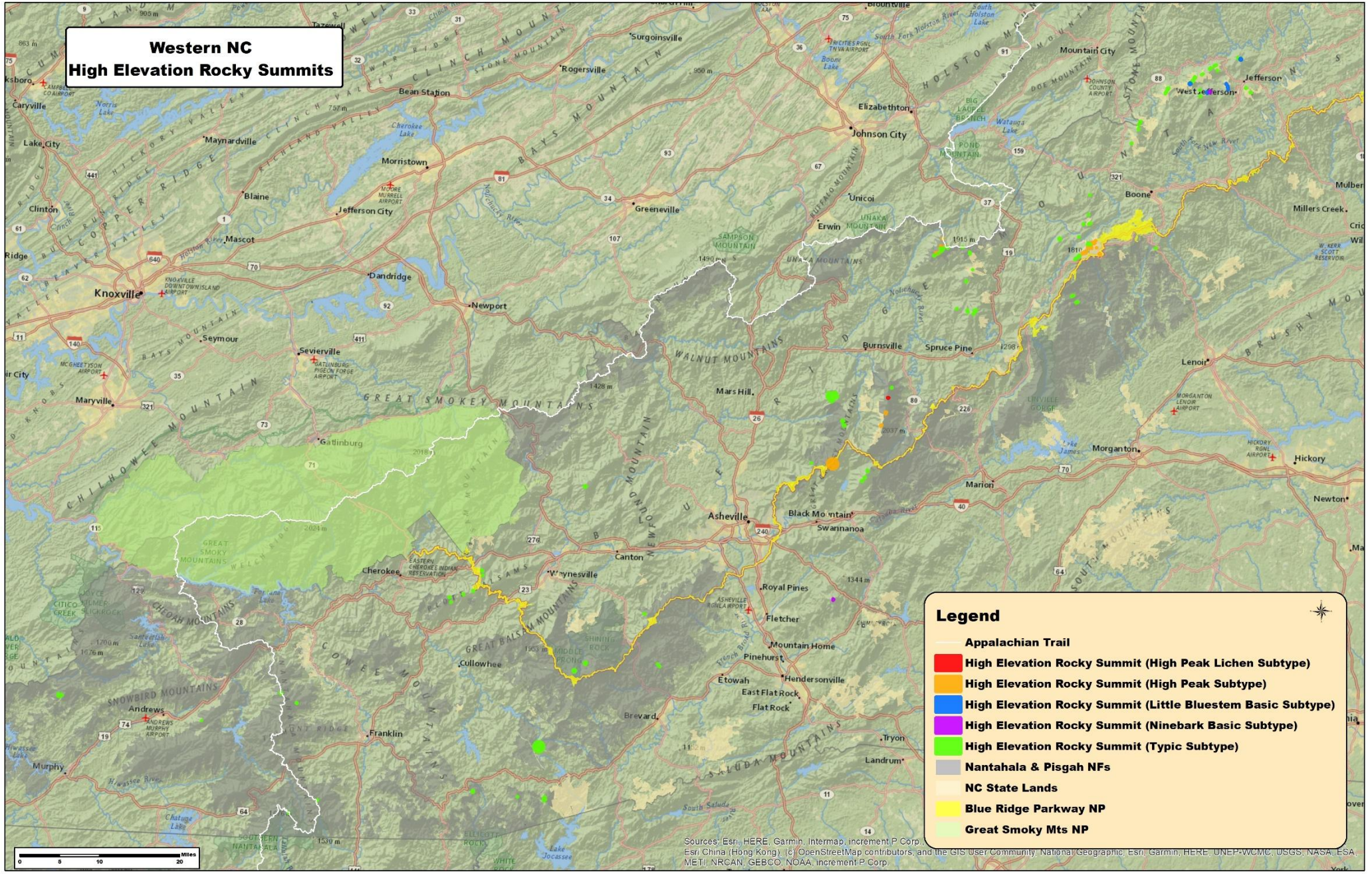
Flat to Vertical
Fractured (craggy) rock with small pockets or crevices
Ridge tops or upper slopes in exposed settings NC, TN
Subtypes vary by elevation, geology, and plant associates
Disturbance freeze and thaw, rock spalling, high winds
Drought although landscape position often bathed in fog deposition
Impacts from climbing, hiking


Chris Ulrey

DO NOT
TREAD, MOSEY, HOP,
TRAMPLE, STEP,
PLOD, TIPTOE, TROT,
TRAIPSE, MEANDER,
CREEP, PRANCE,
AMBLE, JOG,
TRUDGE, MARCH,
STOMP, TODDLE, JUMP,
STUMBLE, TROD, SPRINT,
OR WALK
ON THE PLANTS.

SAN DIEGO ZOO
SAN DIEGO WILD ANIMAL PARK

National Park Service



Rarity

Typic
G2,
NC, TN

High Peak
G1
NC, TN

High Peak Lichen,
G2?
NC, TN

Anakesta
G1
NC, TN

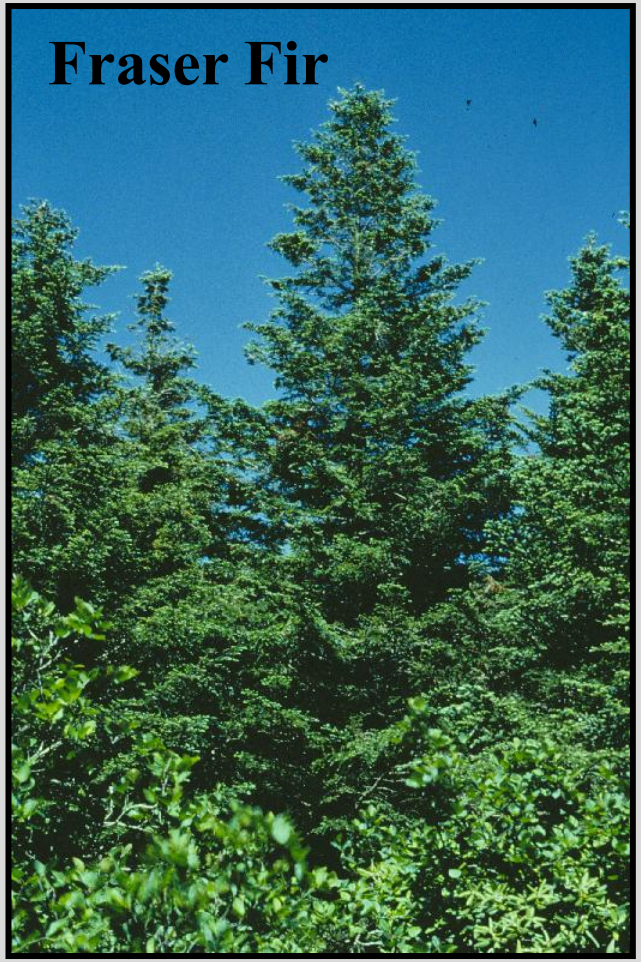
Little Bluestem
G1,
NC, TN

Ninebark
G1,
NC


Chute 1


View from Site 2
Further west
Chute 2

Chute 2



Abies fraseri

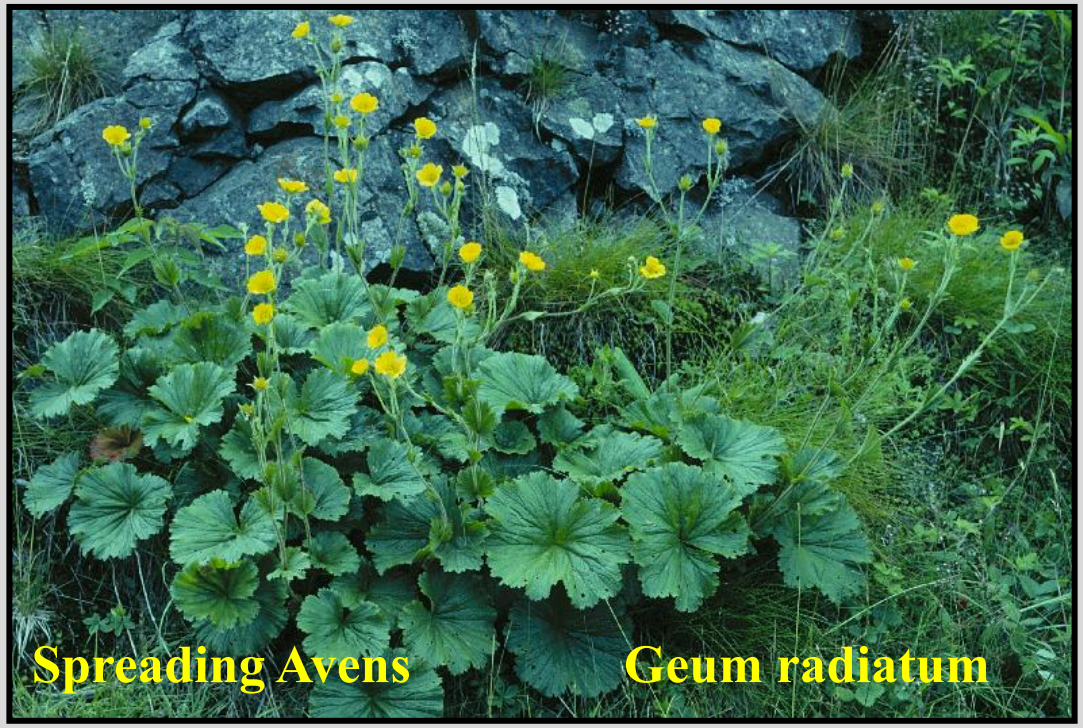
Red Spruce

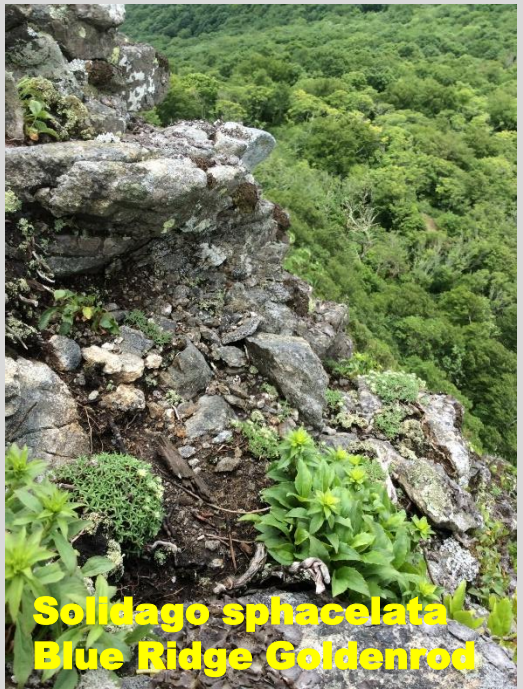
Picea rubens

Sibbaldia tridentata

Three-toothed Cinquefoil

Catawba Rhododendron **Rhododendron catawbiense**

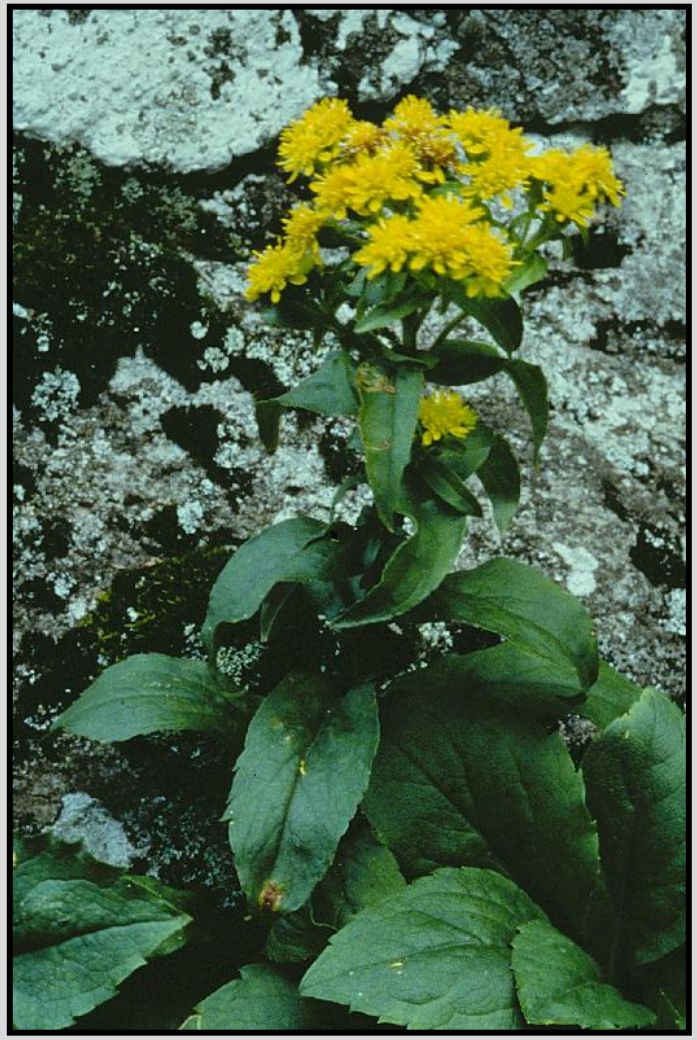




High Peak Subtype

Blue Ridge Goldenrod

Solidago spithamaea



Roan Mountain Bluet

Houstonia montana


Carex misera
Miserable Sedge


Chelone lyonii
Pink Turtlehead

Huperzia porophila
Rock Clubmoss

Low to mid elevation outcrops
Escarpment outcrops in particular
Spray cliffs
Spreading lvs 1 mm wide

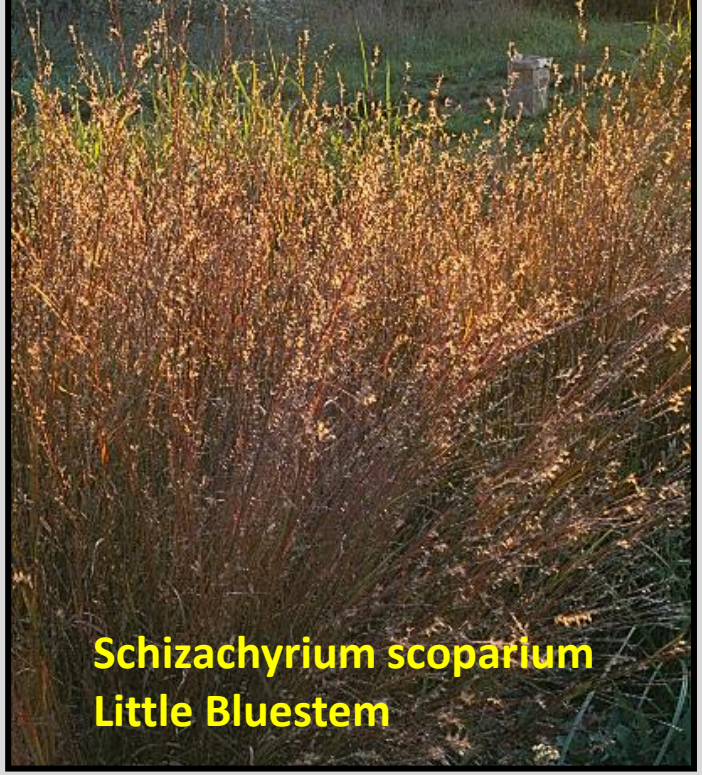
Huperzia appressa
Appalachian Firmoss

High elevation outcrops
More appressed lvs

Heuchera villosa
Hairy Alum Root

Micranthes petiolaris
Cliff Saxifrage

Little Bluestem Basic Subtype

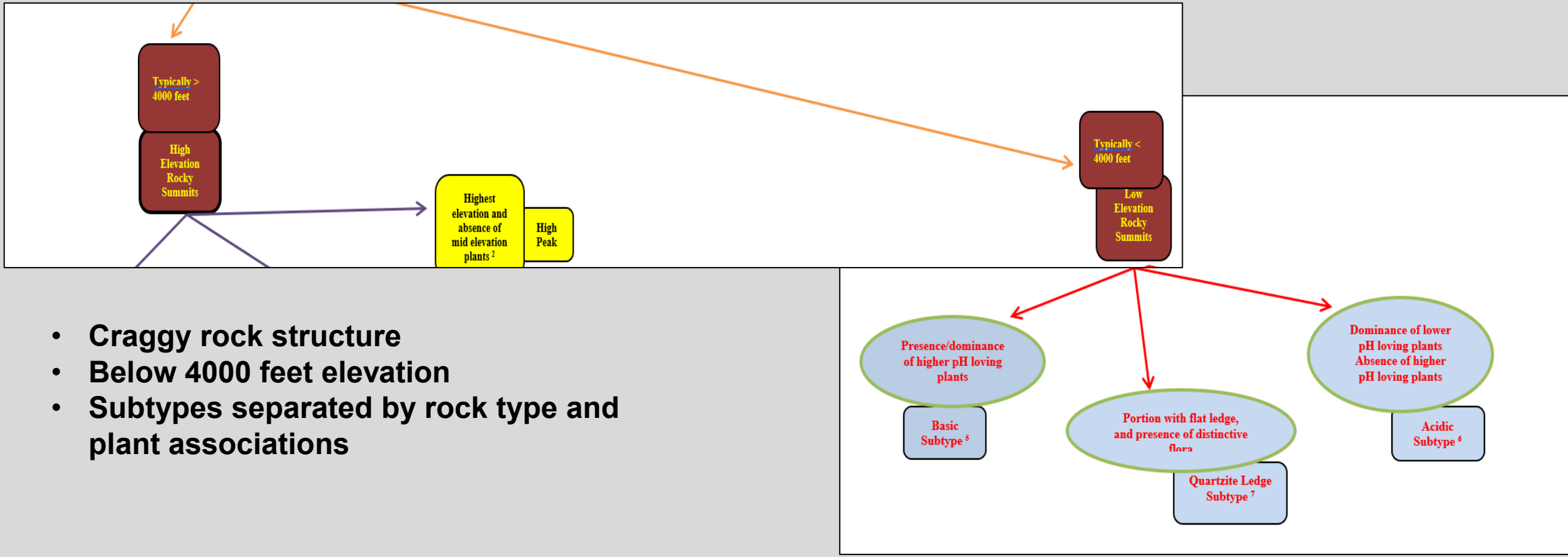


Ninebark Basic Subtype

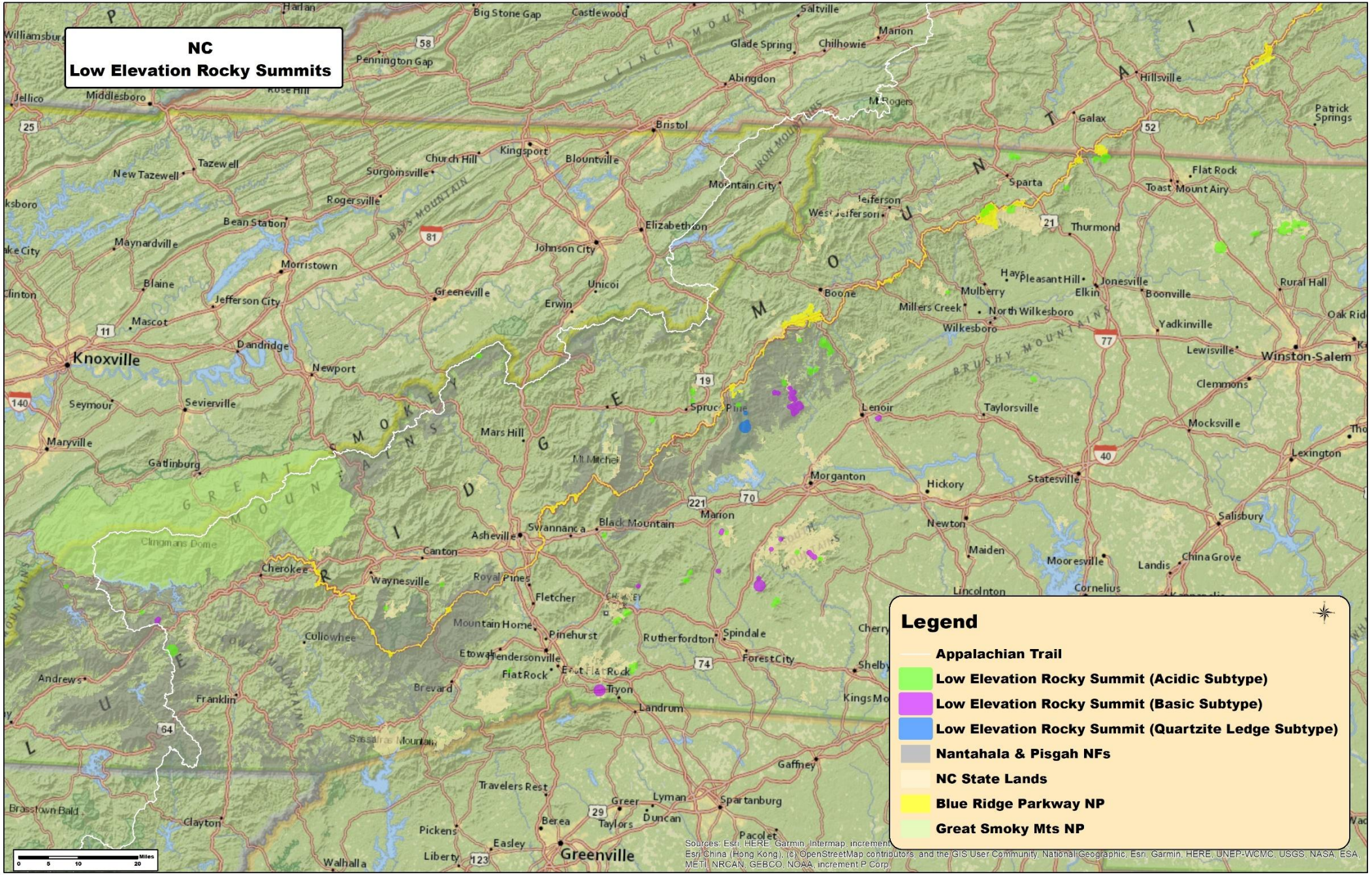
Physocarpus opulifolius

Only known from Bluff Mt in Ashe County

Low Elevation Rocky Summits Flow Chart



- Craggy rock structure
- Below 4000 feet elevation
- Subtypes separated by rock type and plant associations

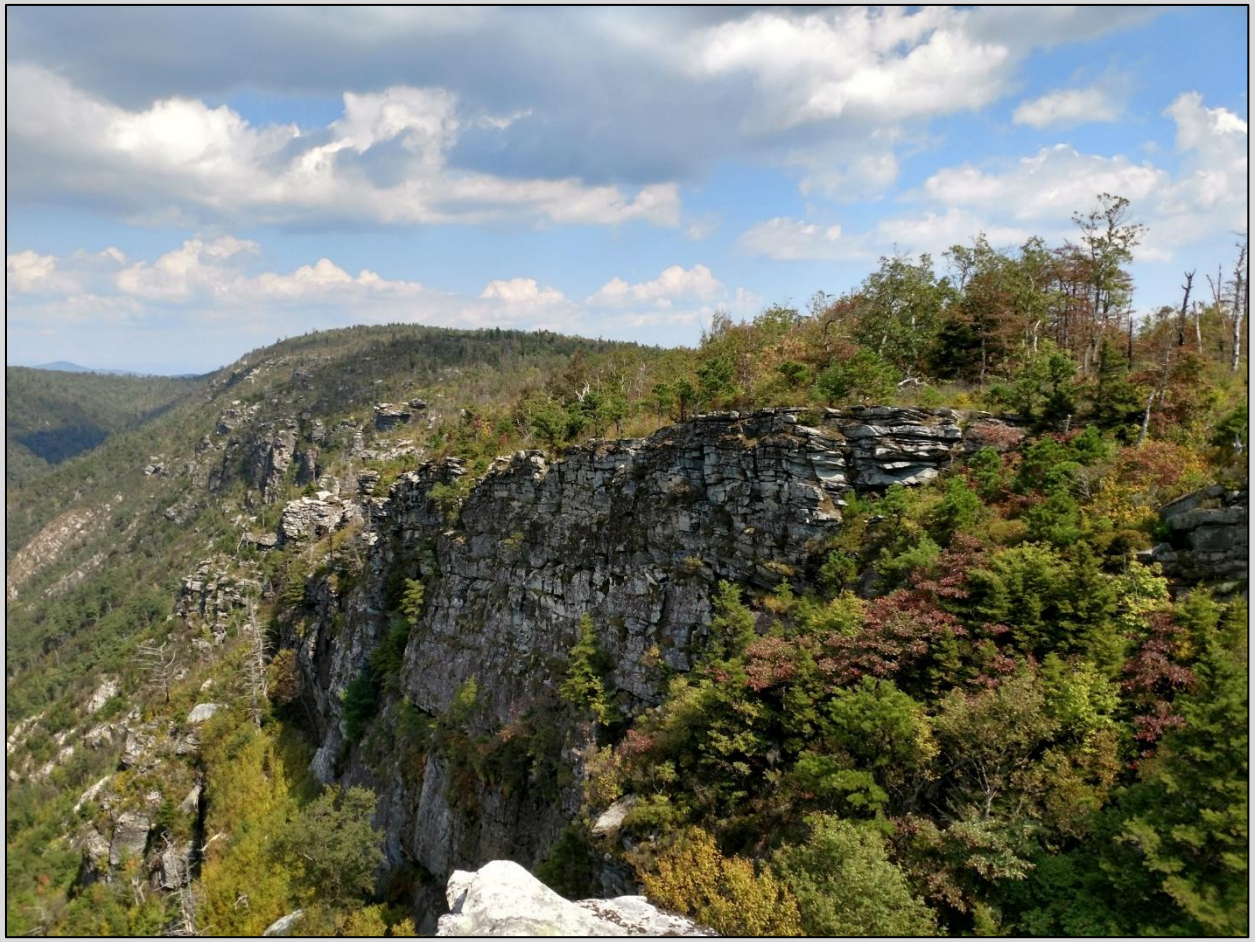


Rarity

Acidic
G3?, S2
GA, NC, SC, TN, VA

Basic
G1, S1
NC, GA?, SC?

Quartzite Ledge
G1, S1
NC



Low Elevation Rocky Summit – Quartzite Ledge

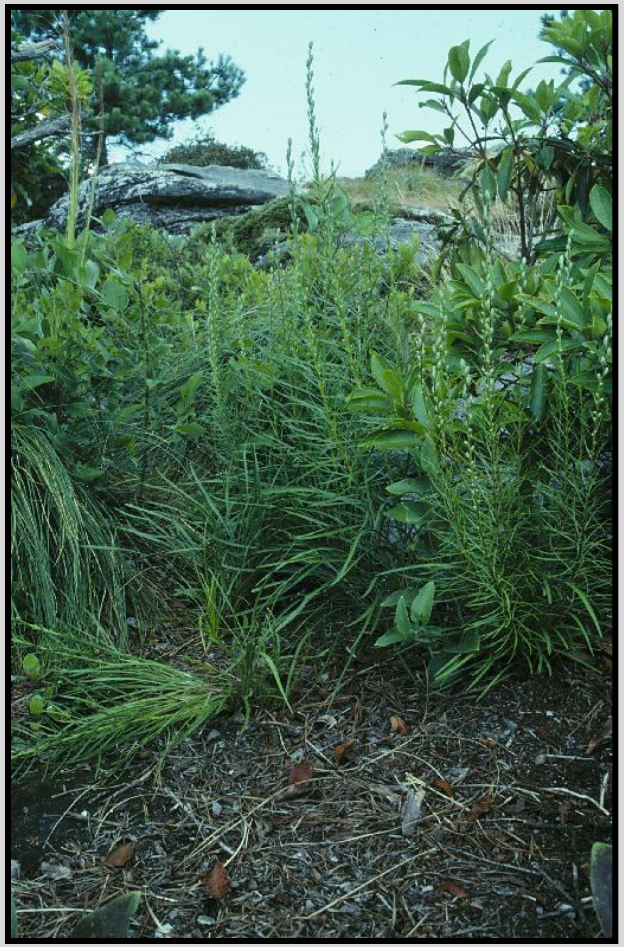
- **Unique to Linville Gorge**
- **Flat-lying quartzite (metamorphosed sandstone dominated by quartz) with limited fracturing**
- **Sparse Patchy vegetation**

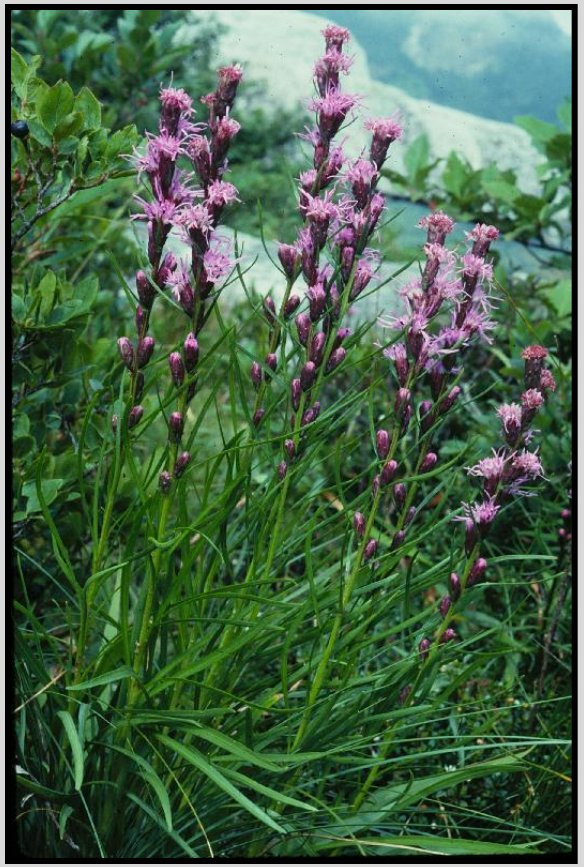
Kalmia buxifolia

Sand-myrtle

Mountain Golden Heather

Hudsonia montana





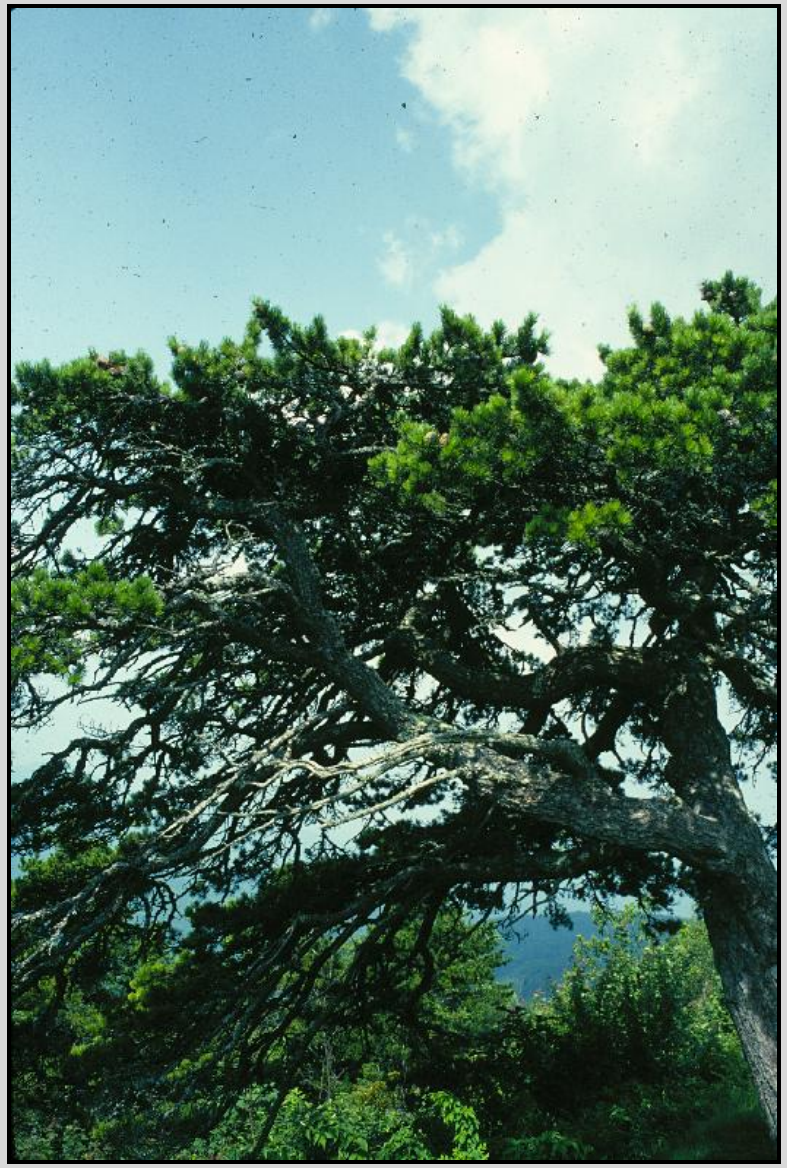
Heller’s Blazing Star

Liatris helleri

Turkey Beard

Xerophyllum asphedeloides

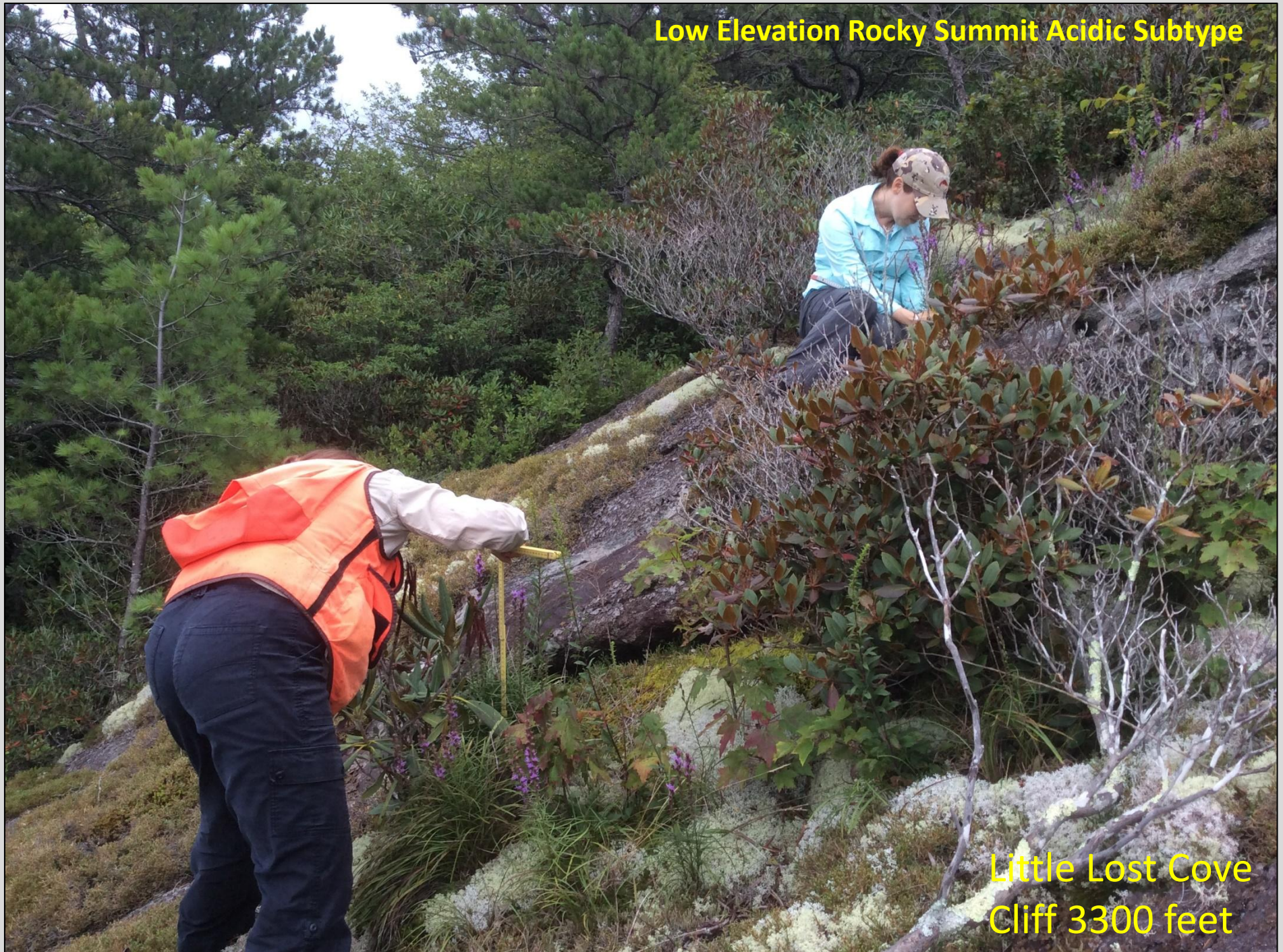
Table Mountain Pine



Pinus pungens

Witch Alder **Fothergilla major**

Mountain Laurel **Kalmia latifolia**



Cladonia lichens

Rhododendron carolinianum (Carolina Rhododendron)

Bryodesma rupestre – Spike Moss

Pinus rigida - Pitch Pine

Pinus pungens – Table Mountain Pine

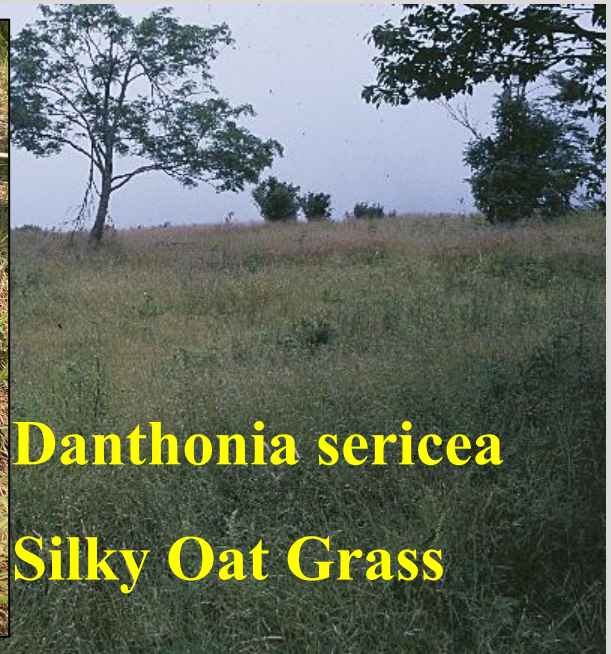
Rhododendron carolinianum
Rock Clubmoss

Flowers early spring, April-May
Linville west to Smokies
Rocky summits, heath balds

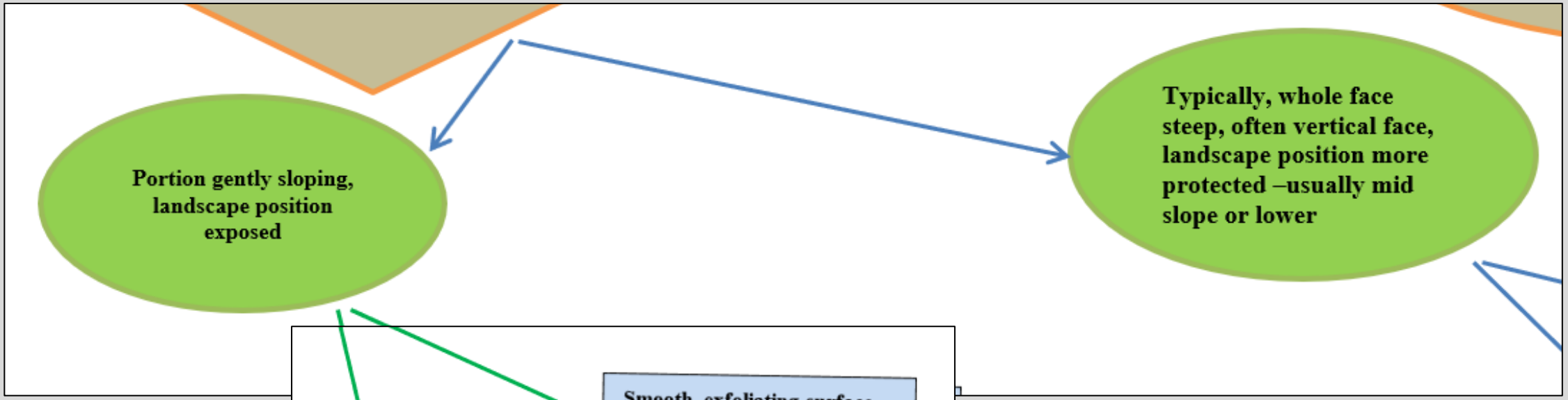
Rhododendron minus
Gorge Rhododendron

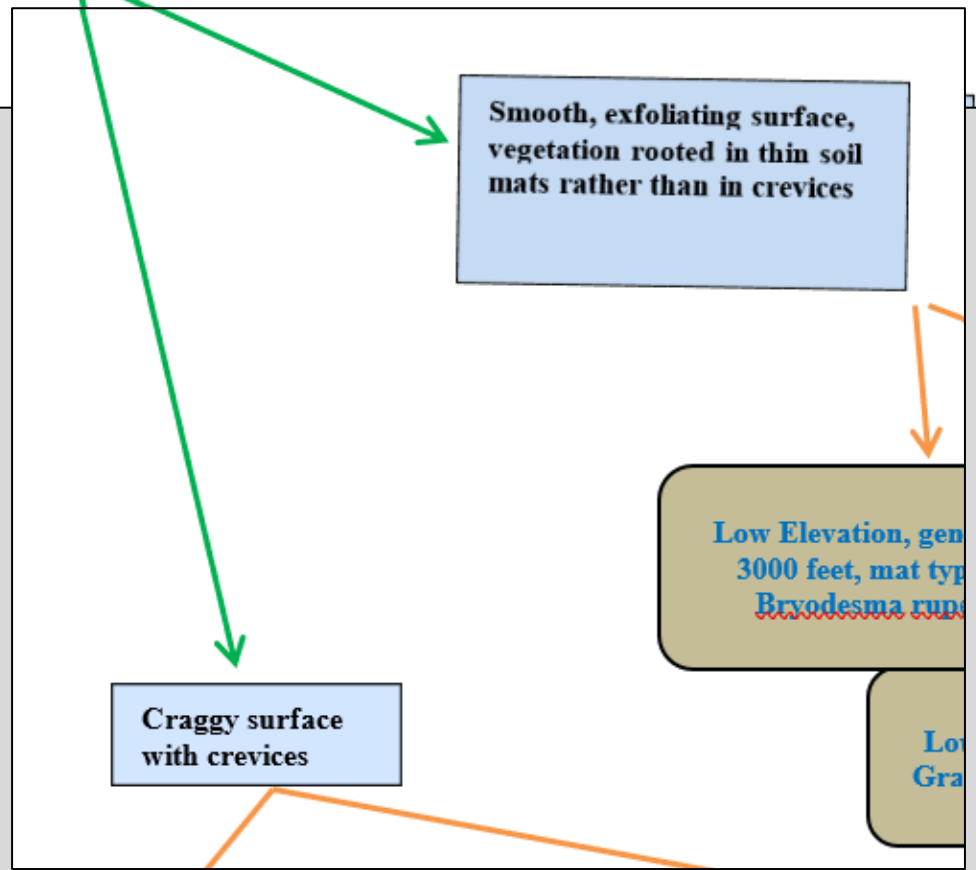
Flowers late spring, June in Mts
Blue ridge Escarpment, Piedmont Granitic Domes

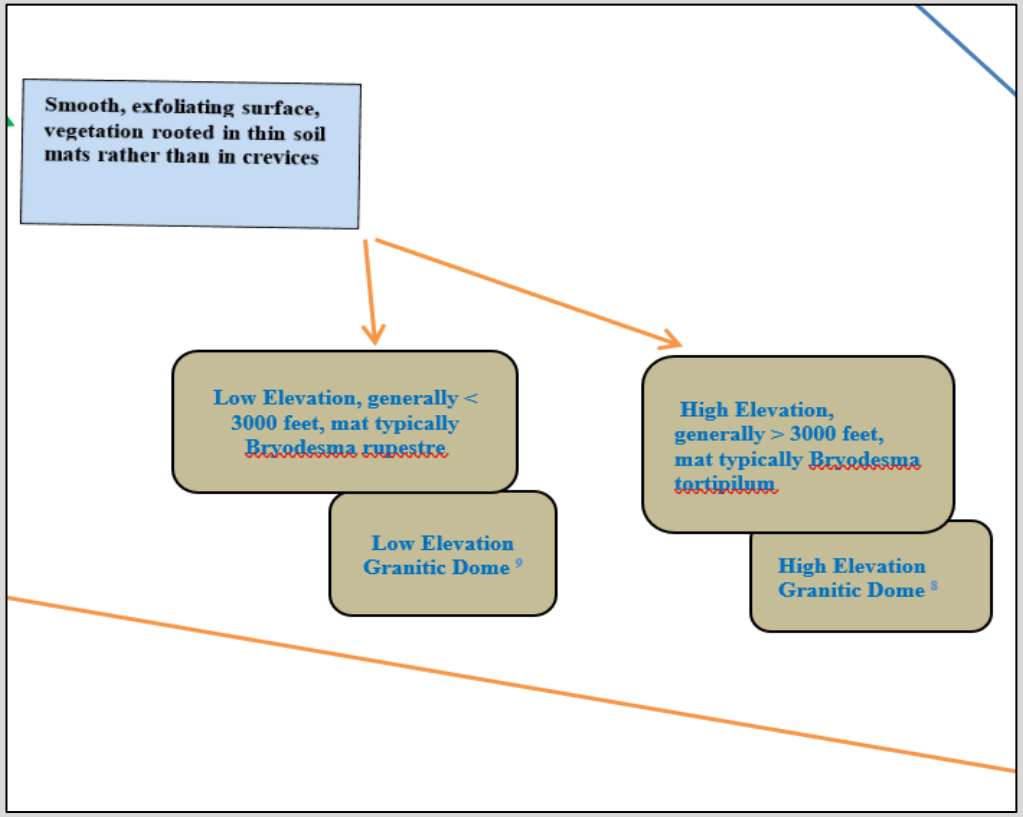
Umbillicate Lichens



Granitic Dome Flow Chart





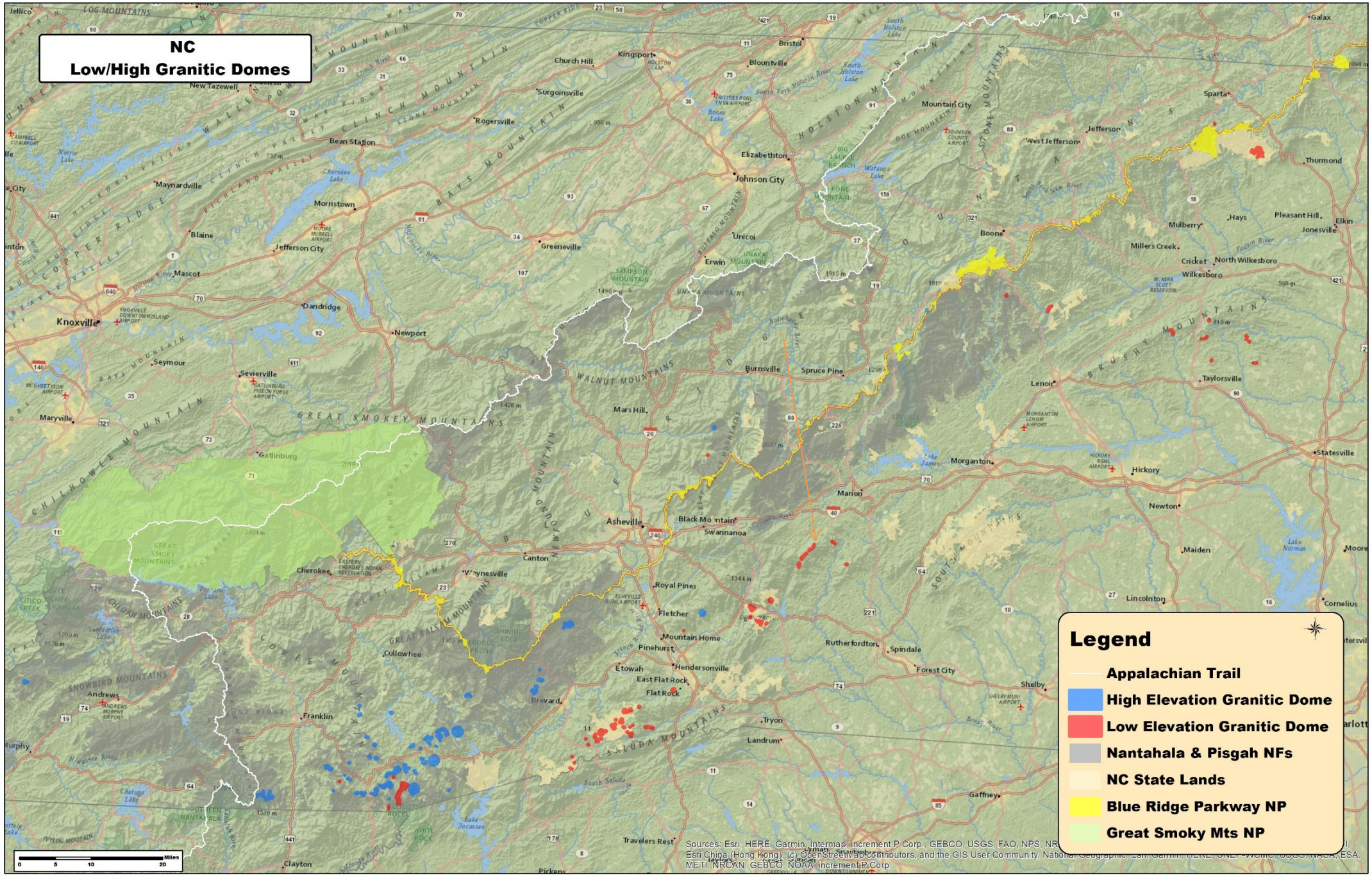


Granitic Domes

Smooth granitic exfoliating surface
Near absence of crevices

Differentiated between low and high by
- elevation (3000 feet divide)
- spike moss mats (toprtipilum high, rupestre low)


High Elevation
Granitic Dome



Rarity

High Elevation
G2G3
NC, SC, GA, TN?
NC-S3, SC-SNR
GA-SNR

Low Elevation
G2
NC-S2, SC-?, GA-SNR, AL-S1

Bryodesma rupestre
Rock Spikemoss

Bryodesma tortipilum
Twisted-hair Spikemoss

Juniper communis var. depressa
Ground Juniper

Rare in NC in wild – 2 locations
Cultivars often planted in landscape

Solidago simulans

Granite Dome Goldenrod

Robinia viscosa var hartwigii

Robinia hartwigii

Granite Dome Locust

Deerhair Bulrush

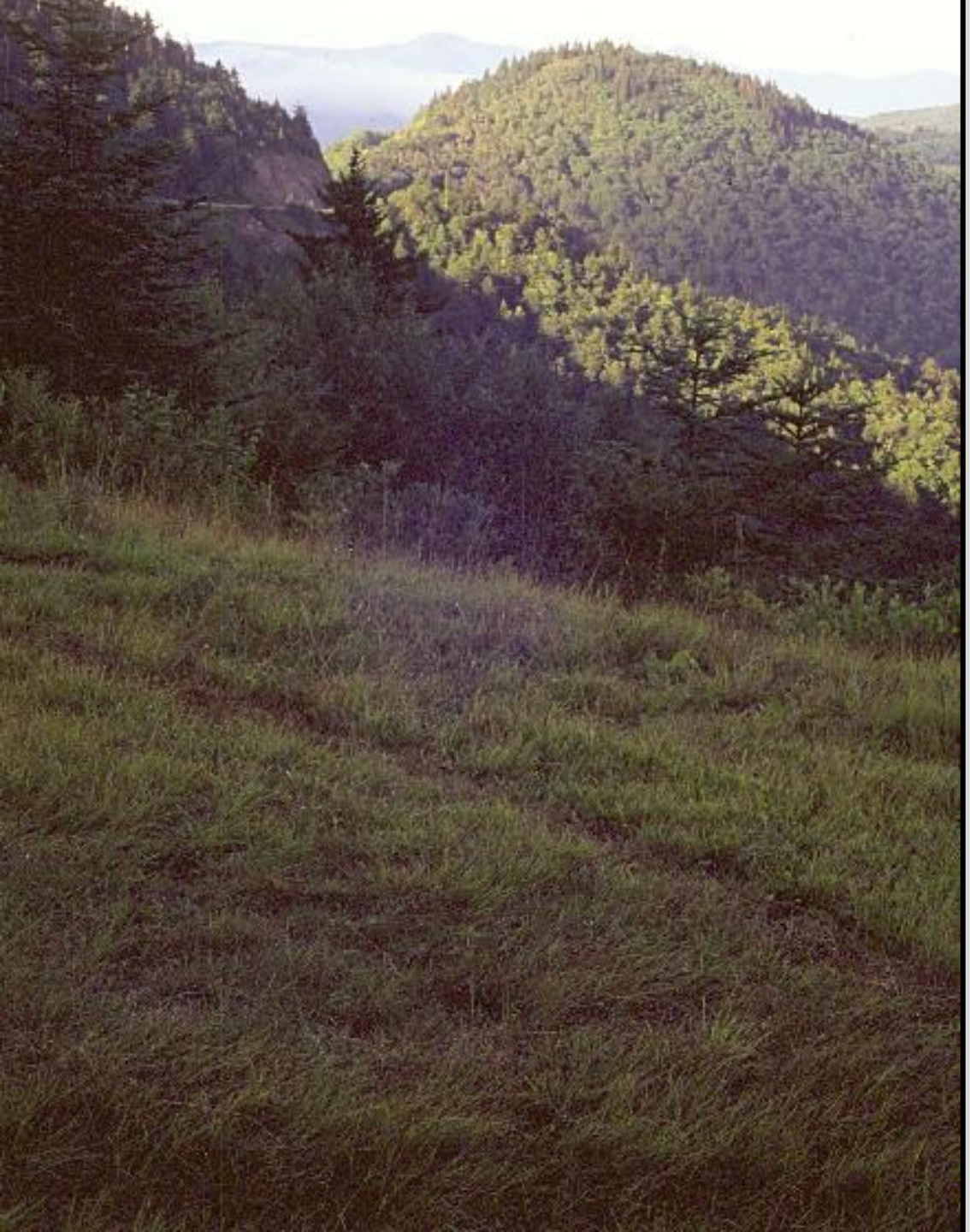
Trichophorum cespitosum

Packera millefolium

Blue Ridge Ragwort

Hybridizes with Packera anonyma

Packera x memmingeri



Danthonia compressa

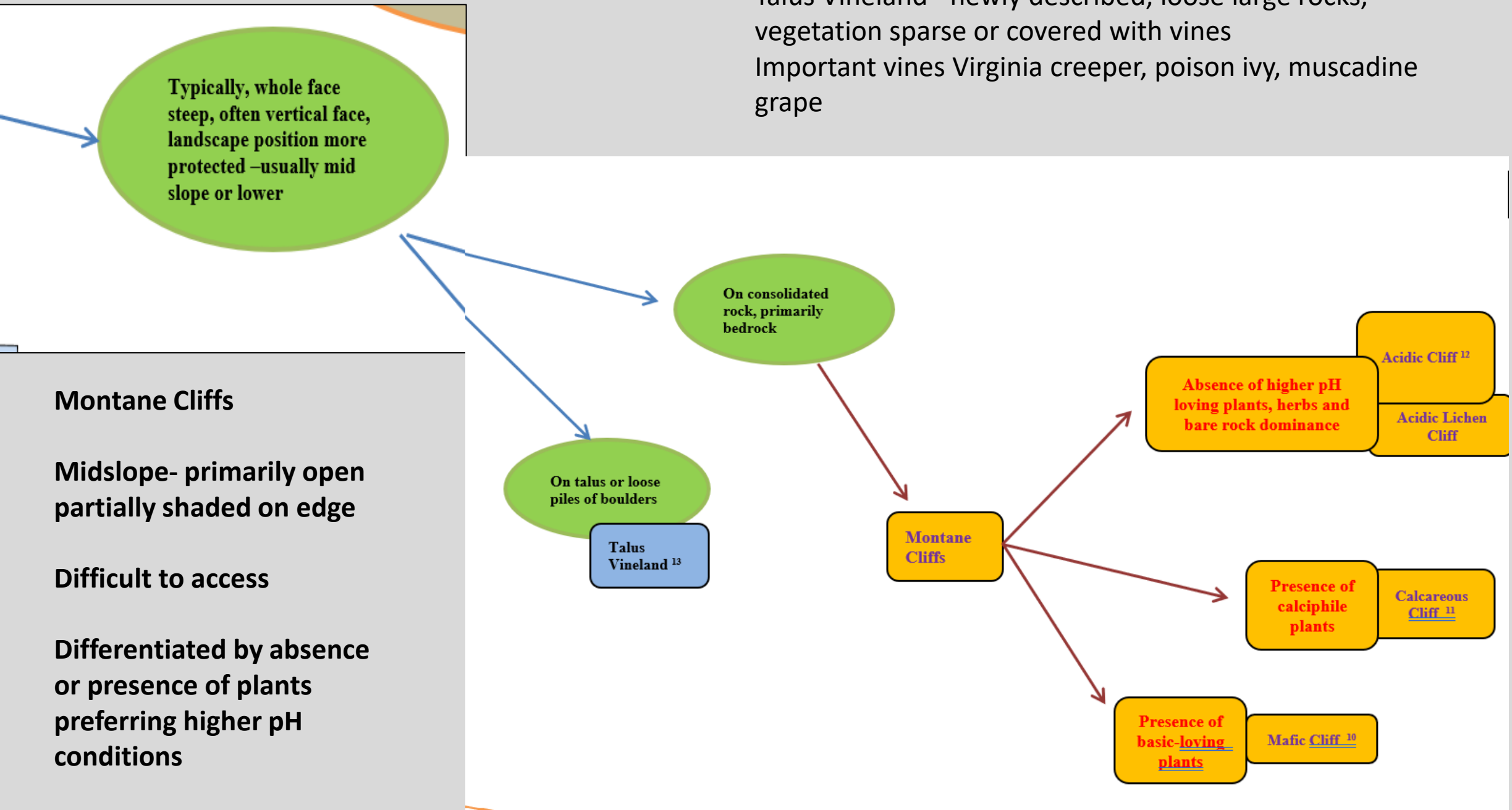
Mountain Oat-grass

Low Elevation Granitic Dome


Fringe Tree
Chionanthus virginicus

Montane Cliff & Talus Vineland Flow Chart

Talus Vineland –newly described, loose large rocks, vegetation sparse or covered with vines
Important vines Virginia creeper, poison ivy, muscadine grape

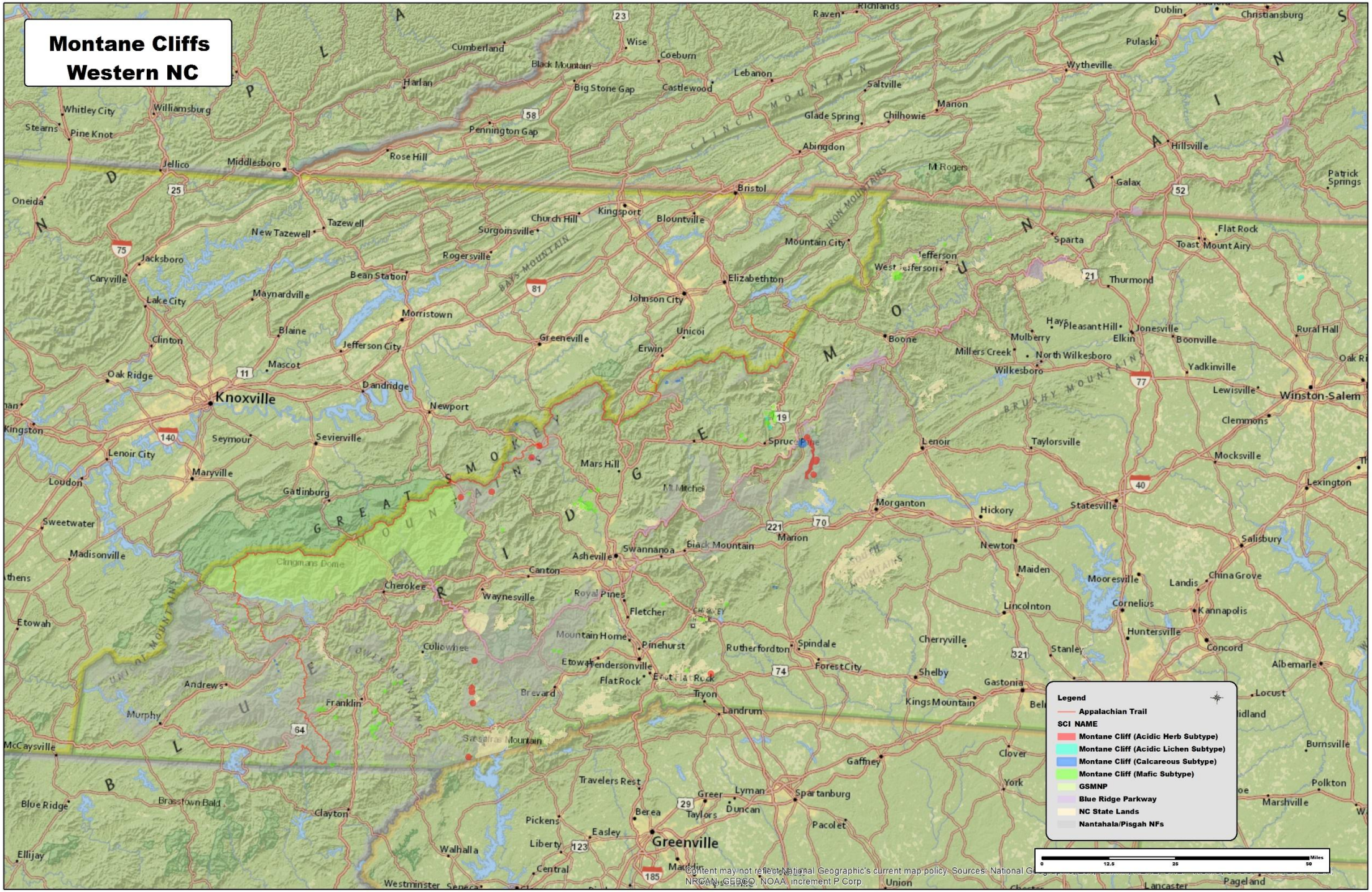


Montane Cliffs

Midslope- primarily open partially shaded on edge

Difficult to access

Differentiated by absence or presence of plants preferring higher pH conditions



Rarity

Acidic Herb
G3G4, S3
GA, SC, NC, TN, VA?

Acidic Toadskin Lichen
G2?, S1
NC

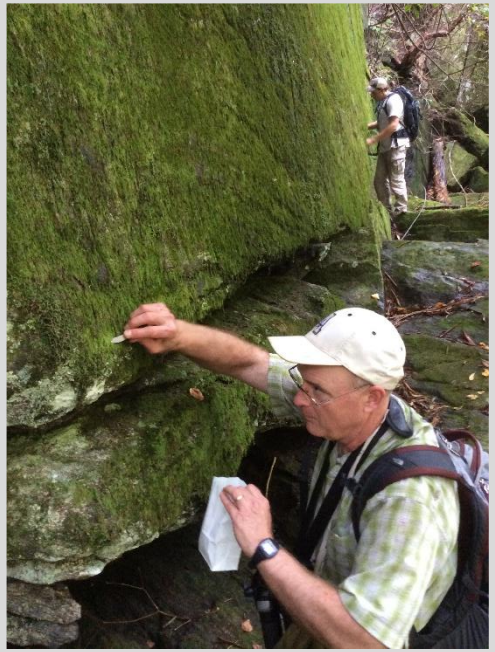
Acidic Rock Tripe, G4, S3?
CT south to TN & GA

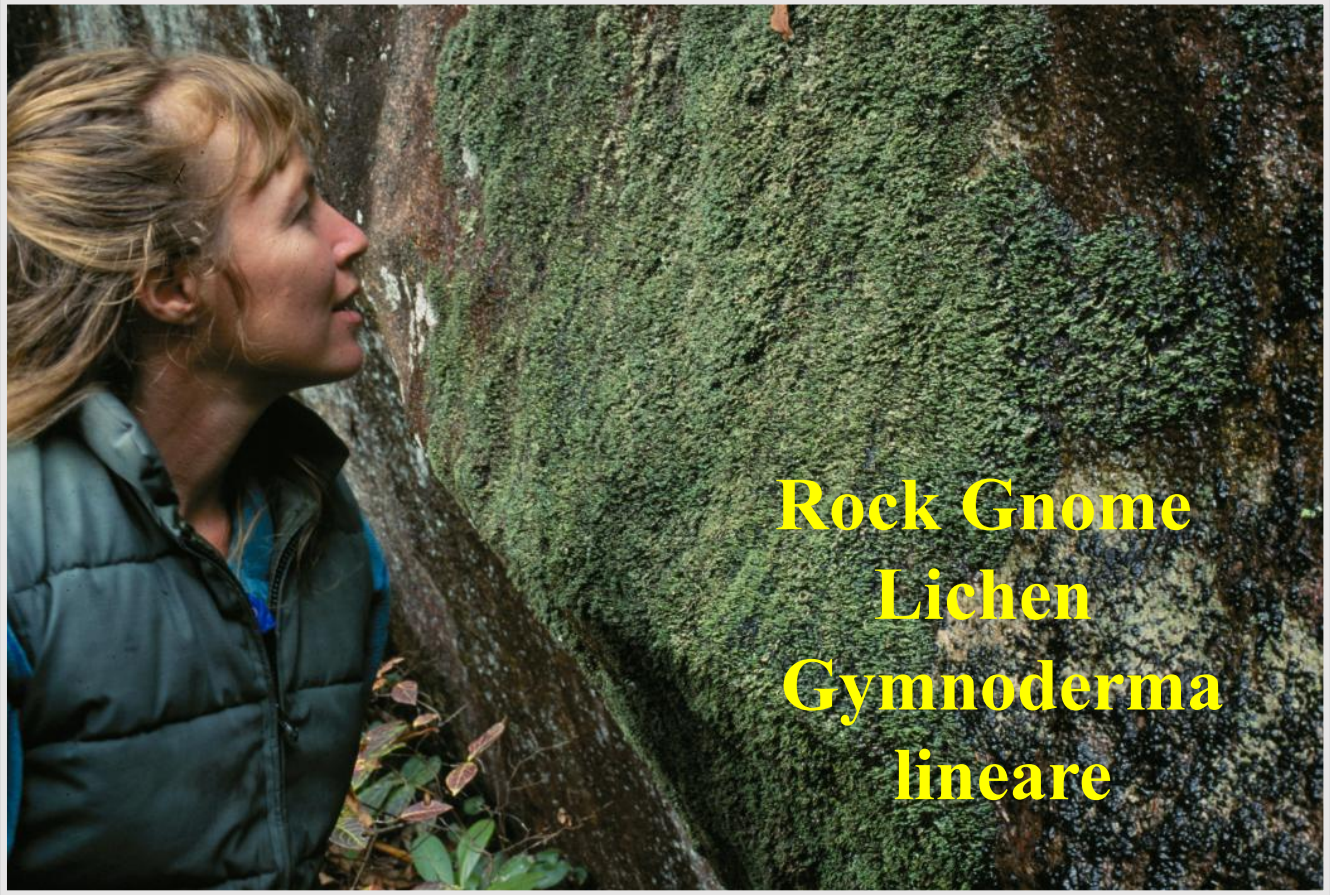
Calcareous
G3G4, S1
AL-PA

Mafic
G23, S3
GA, SC, NC, AL?,VA?

Acidic Subtype

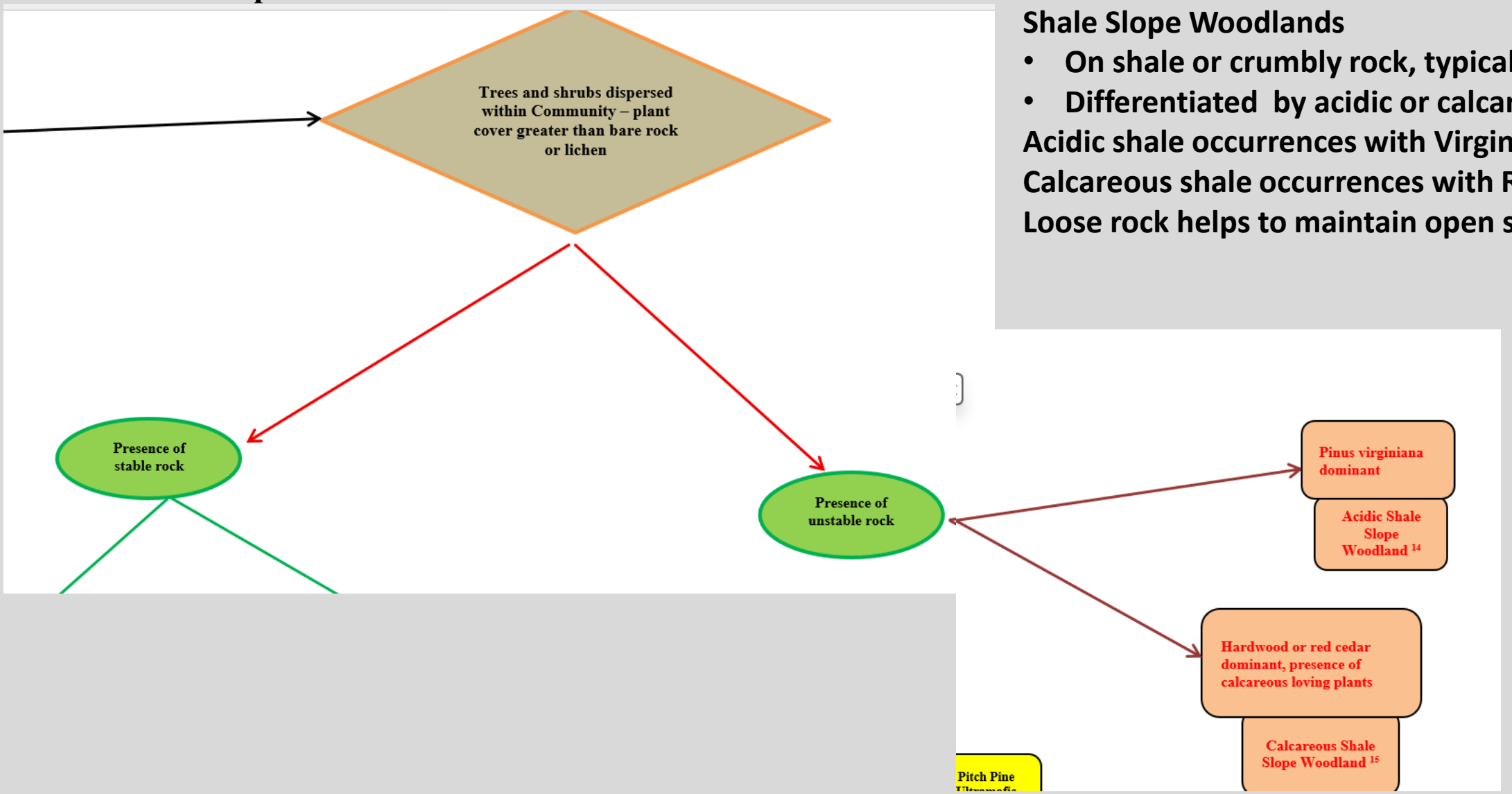
Montane Cliffs – Acidic Subtype






Buckleya
distichophylla
Pirate Bush

Shale Slope Flow Chart



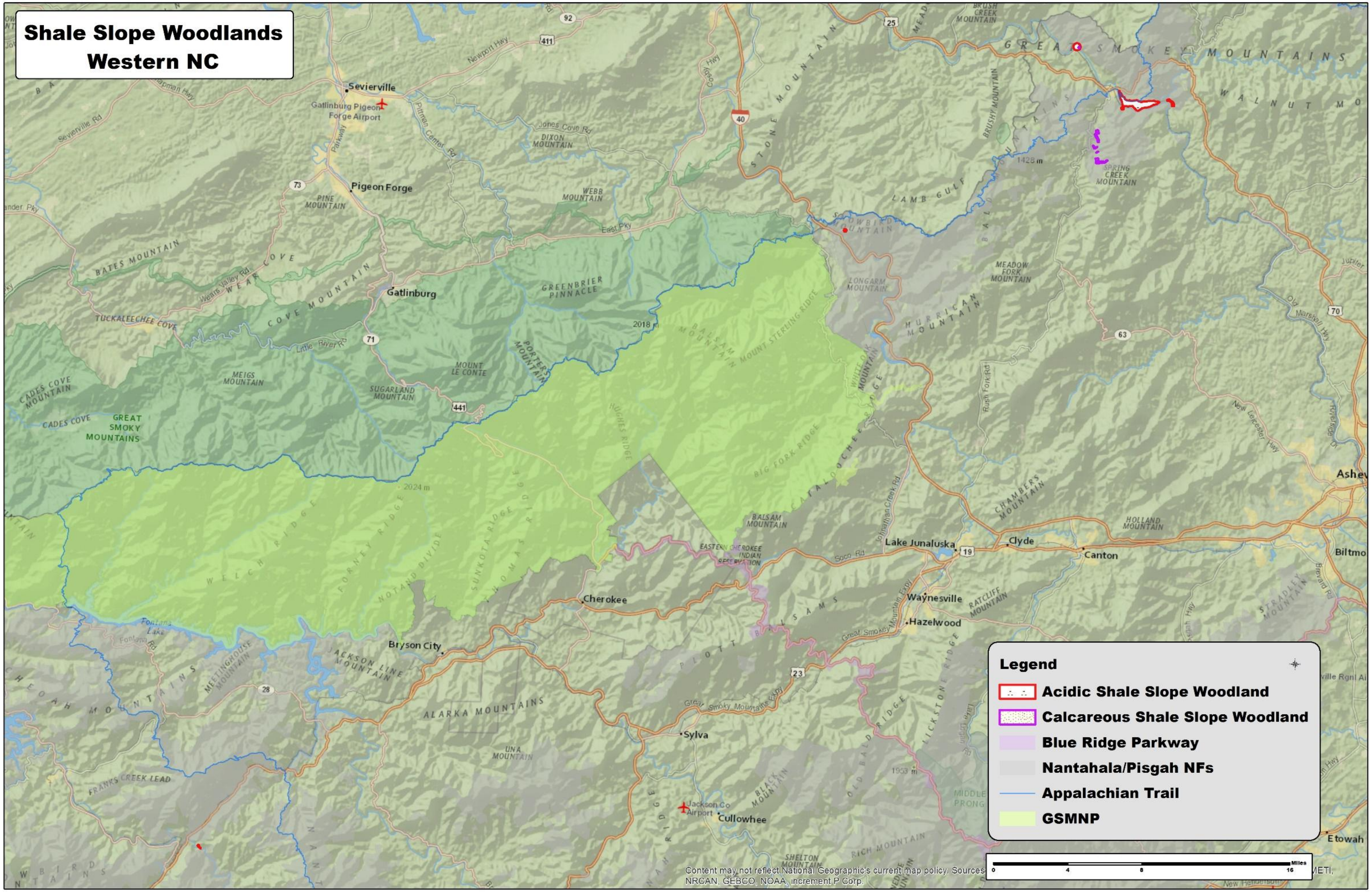
Shale Slope Woodlands

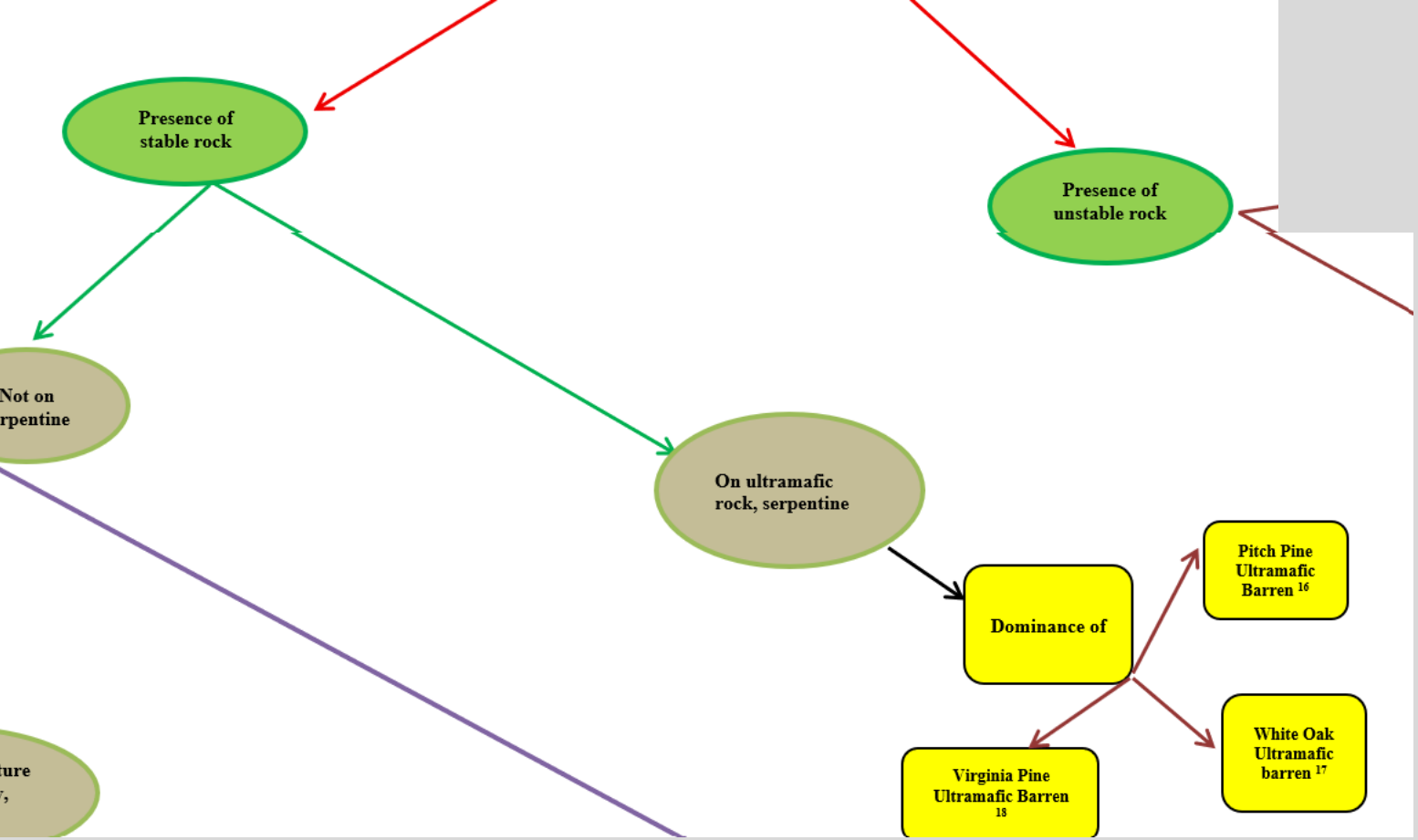
- On shale or crumbly rock, typically river bluffs
- Differentiated by acidic or calcareous rock

Acidic shale occurrences with Virginia Pine

Calcareous shale occurrences with Red Cedar

Loose rock helps to maintain open structure


Shale Slope Woodlands
Western NC
Legend
Acidic Shale Slope Woodland
Calcareous Shale Slope Woodland
Blue Ridge Parkway
Nantahala/Pisgah NFs
Appalachian Trail
GSMNP
Miles
0
4
8
16
Sevierville
Gatlinburg Pigeon Forge Airport
Pigeon Forge
Gatlinburg
GREAT SMOKY MOUNTAINS
Cherokee
Bryson City
Sylva
Cullowhee
Jackson Co Airport
Lake Junaluska
Clyde
Canton
Waynesville
Hazelwood
Etowah
EASTERN CHEROKEE INDIAN RESERVATION
GREAT SMOKEY MOUNTAINS
WALNUT MOUNTAINS
SPRING CREEK MOUNTAIN
BALSAM MOUNTAIN
PLOTT BALSAMS
ALARKA MOUNTAINS
Content may not reflect National Geographic's current map policy. Sources: ... METI, NRCAN, GEBCO, NOAA, increment P Corp.



Ultramafic Barrens

- On serpentine rock with higher magnesium content
- Three subtypes differentiated by dominate tree species
- Very rare occurring as small islands separated from other occurrences
- Includes some single site endemics
- Open woodland maintained with fire


Serpentine Barren/Woodland

Prairie Dropseed

Sporobolus heterolepis

Symphyotrichum rhiannon

Stoloniferous basal leaves

Cauline Leaves clasping stem

Cauline leaf margin serrated rough to the touch, tapering to petiole


Alan Cressler


Phyllary apices rhombic-lanceolate

Rhiannon

Weakley

Budding

Taxonomist

Serpentine Ragwort

Packera serpenticola

Packera serpenticola
Serpentine Ragwort

Endemic

Similar to Packera aurea
Leaves rounded, toothed margins
Densely tomentose leaves, stems, flowers
Densely clumped
Blooms April-May

Asarum sps #1

Endemic

Similar to Asaraum arifolia var arifolia

Leaves sagitate, straight sides

Calyx lobes erect

Rhizomatous habit, more open habitat

Gentianopsis crinata

Fringed Gentian

3 sites in NC

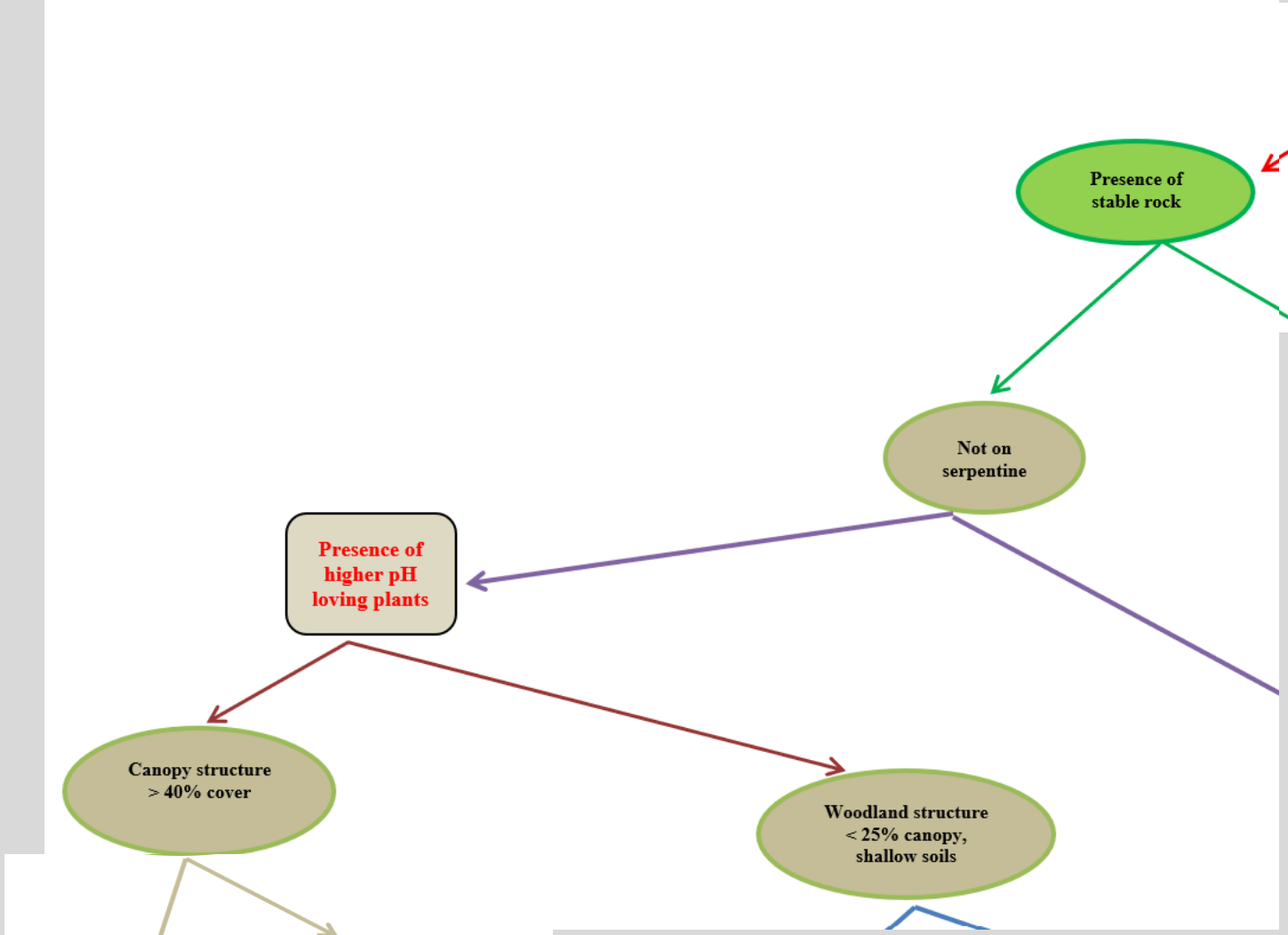
Northeastern species near southern edge of range

Primarily Southern Appalachians

13 recent occurrences, on hardwood bark

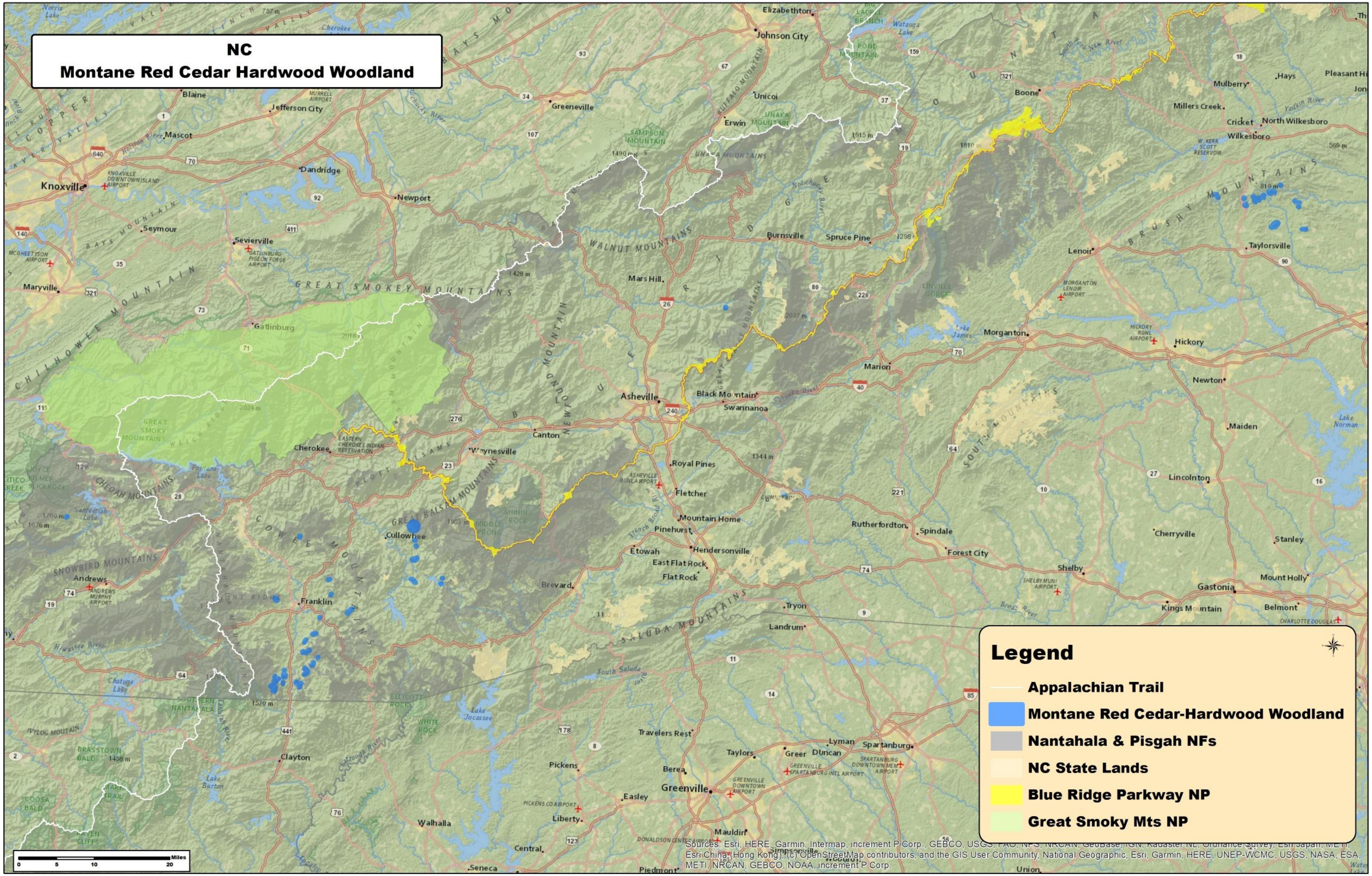
Tip lateral leaf single cell recurved

Underleaves bilobed, single cell lobes



Montane Red Cedar Hardwood Woodlands

- On higher base rock
- Dominated by red cedar and hardwoods
- Other rock outcrop communities with red cedar but not at higher density
- Uncertain if maintained by fire since red cedar not fire tolerant but other associated grasses are


NC
Montane Red Cedar Hardwood Woodland
Legend
Appalachian Trail
Montane Red Cedar-Hardwood Woodland
Nantahala & Pisgah NFs
NC State Lands
Blue Ridge Parkway NP
Great Smoky Mts NP
Miles
0 5 10 20
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community, National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

Juniperus virginiana
Red Cedar


Scott Ward

Coreopsis pubescens

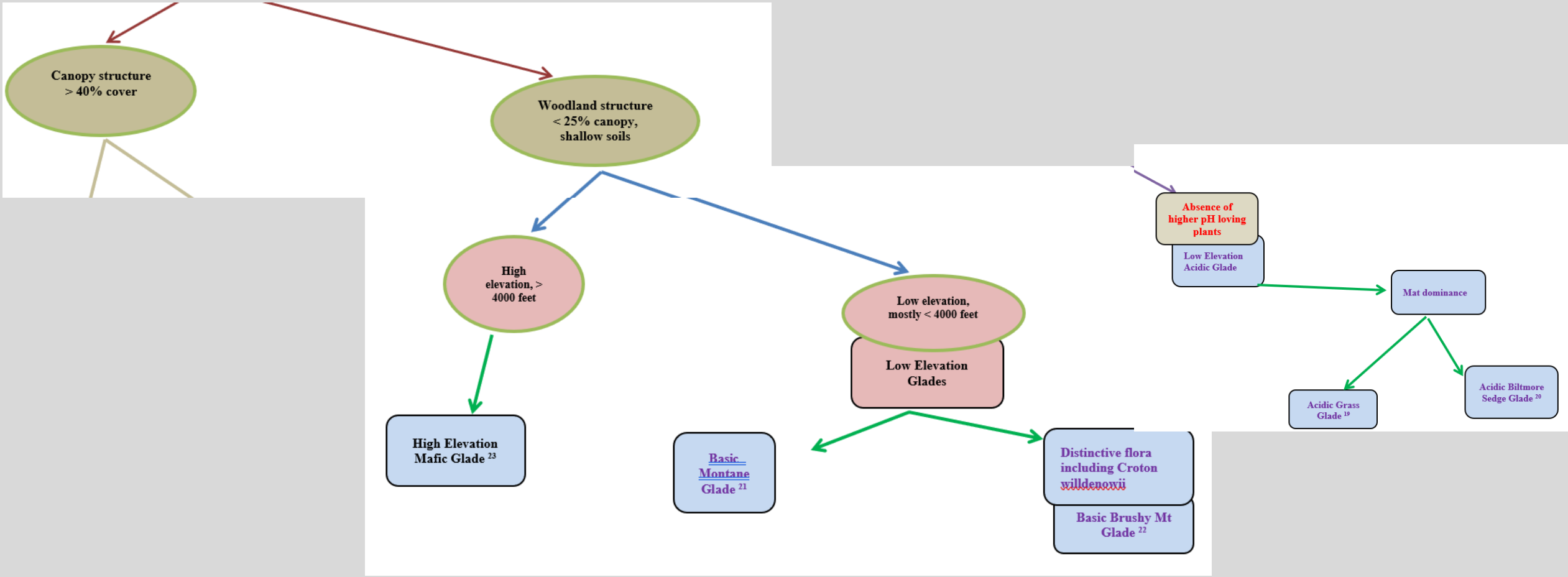
Common Hairy Coreopsis

Phemeranthus teretifolius

Appalalachian Fameflower

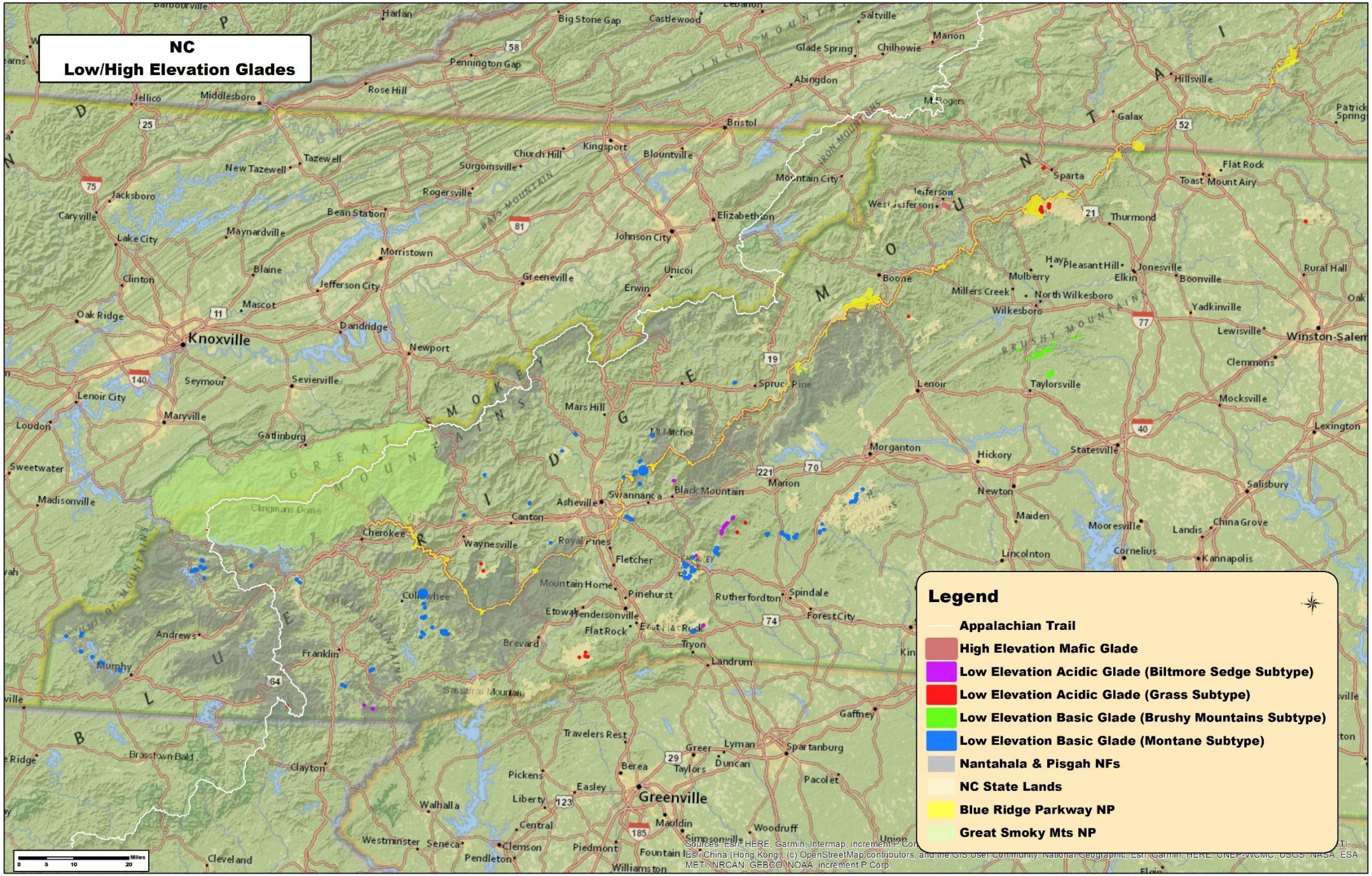

Sedum glaucophyllum
Cliff Stonecrop


Stonecrop
Sedum ternatum



Glades

- On variable rocks
- Differentiated by elevation, acidic rock types, main associated species, or soils with higher base saturation and pH
- Generally small occurrences
- Open woodland maintained with fire for basic types
- Uncertain about acidic grass and Biltmore sedge types



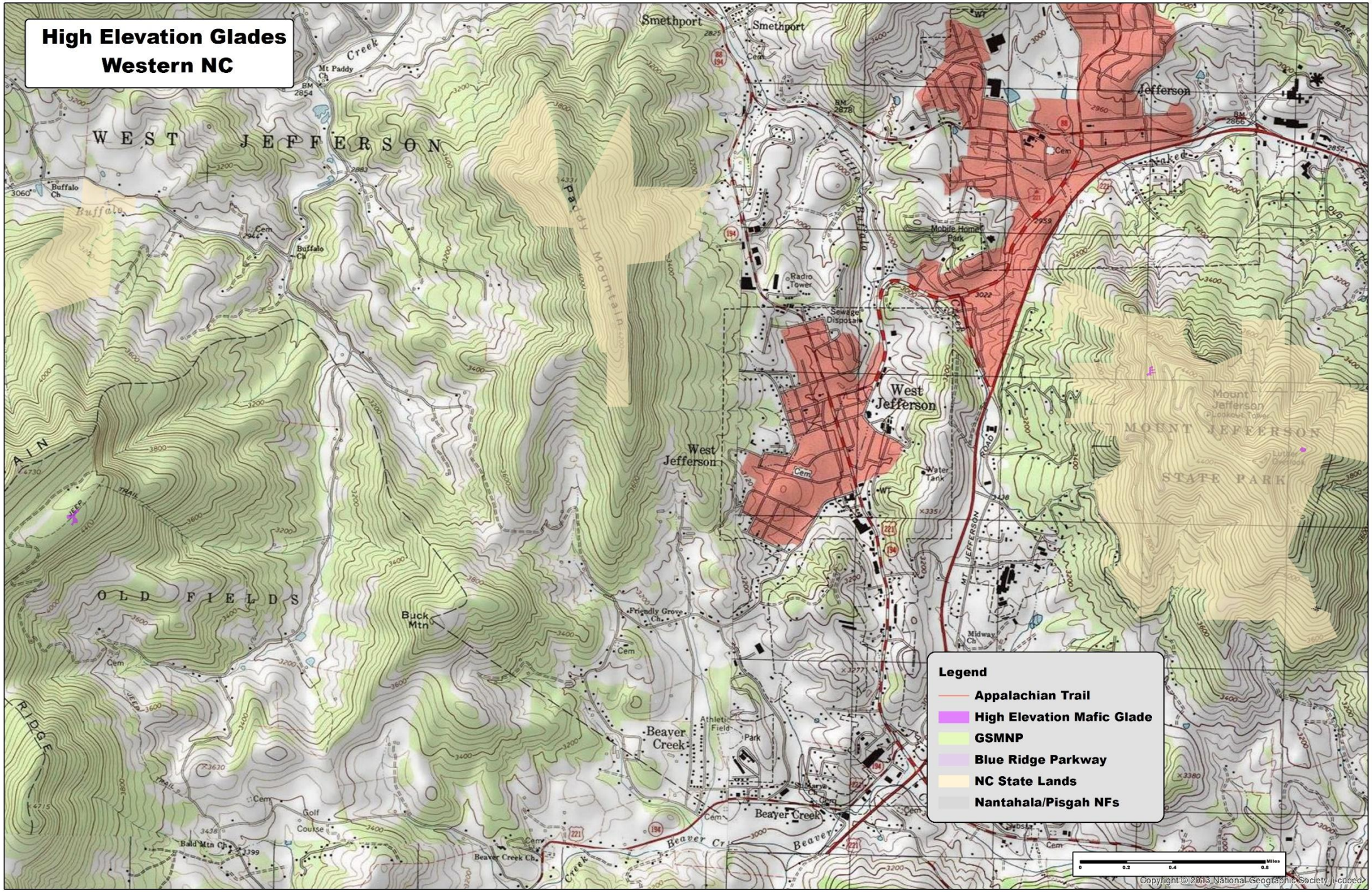
Rarity

Acidic Sedge
G2G3, S2
NC, SC?, GA?

Acidic Grass
G2, S2
NC, SC?

Basic Montane
G2, S2
NC, VA, SC?

Basic Brushy Mountain
G2, S1
NC, VA



Rarity

G1, S1
NC, VA, TN?


Low Elevation Basic Glade


Armine Weise


Armine Weise

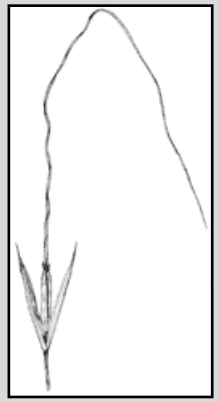

Armine Weise

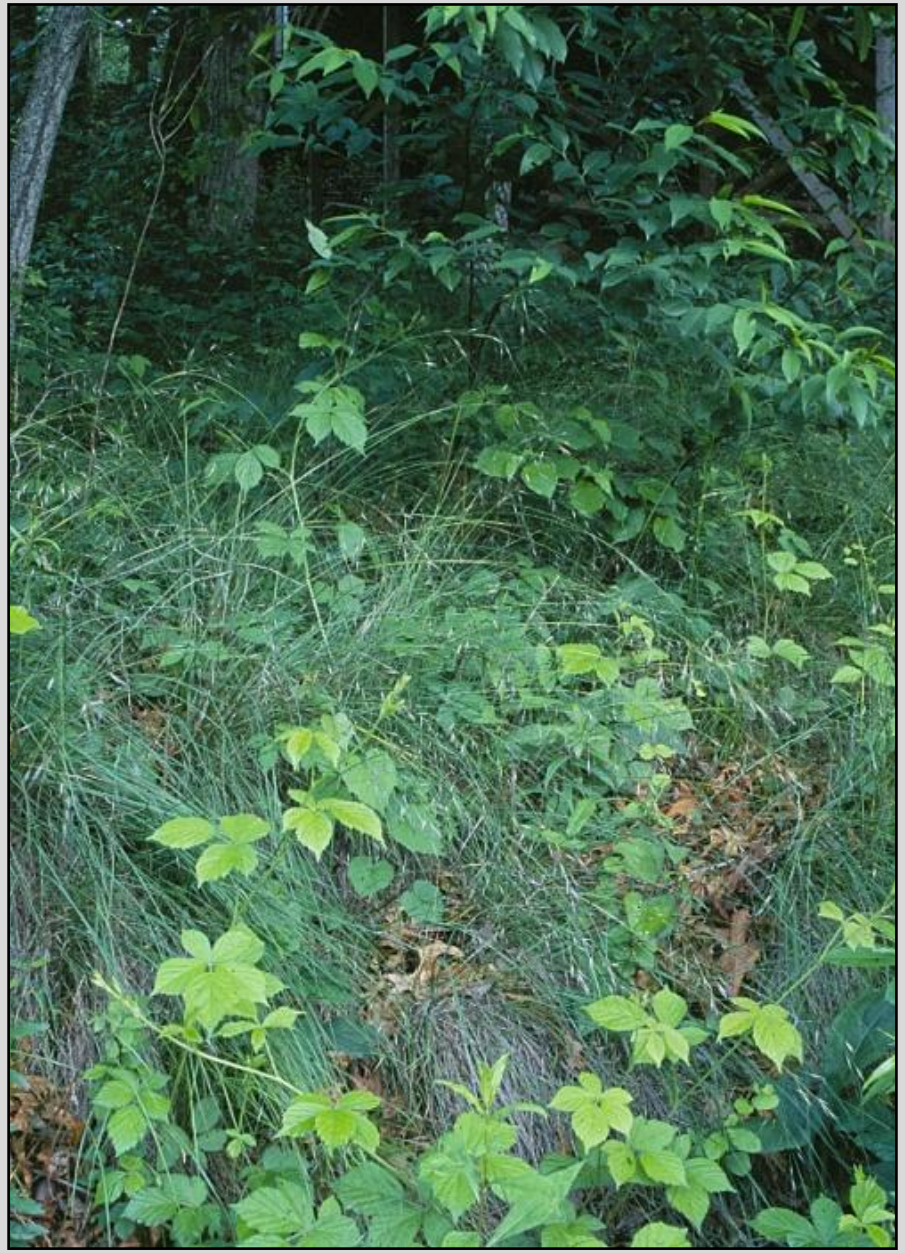

Armine Weise


Josh Kelly


Josh Kelly

Piptochaetium avenaceum
Needle Grass





Symphotrichum pratense
Barrens Silky Aster

Penstemon canescens
Appalachian Beardtongue

Amelanchier sanguinea
Roundleaf Serviceberry

Opuntia cespitosa – Common Eastern Prickly-pear

Opuntia & Myriopteris - Lipfern


Primula meadia
Shooting Star
Armine Weise


Allium cernuum
Nodding Onion
Josh Kelly


Viola pedata
Birds'-foot violet
Armine Weise

Porter’s Reed Grass

Calamagrostis porteri

Phlox subulata - Thrift

Packera anonyma - mosses

Spiraea japonica infestation


Biltmore Sedge Low Elevation Glade
Armine Weise


Solidago spithamea
A
B
C
D

Plant Community Web Sites

Classification of the Natural Communities of North Carolina
https://www.ncnhp.org/classification-natural-communities-north-carolina-4th-approximation

The Natural Communities of Virginia: Classification of Ecological Groups and Community Types - Third Approximation (Version 3.3)-- Information current as of March 2021 https://www.dcr.virginia.gov/natural-heritage/natural-communities/

South Carolina Plant Communities 1986 pdf
https://heritagetrust.dnr.sc.gov/pdfs/SC_Natural_Communities_Nelson_1986.pdf

Georgia's Natural Communities and Associated Rare Plant and Animal Species: Thumbnail Accounts
https://georgiawildlife.com/sites/default/files/wrd/pdf/rare-data/natural_communities_thumbnail_accounts.pdf

Guide to Natural Communities of North Georgia
https://www.naturalcommunitiesofgeorgia.com/

TN-KY Plant Atlas Ecological Community
https://tennessee-kentucky.plantatlas.usf.edu/EcologicalCommunities.aspx

Questions