Smoky Mountain Ecology

By Marty Miller

GREAT SMOKY MOUNTAIN NATIONAL PARK FACTOIDS:

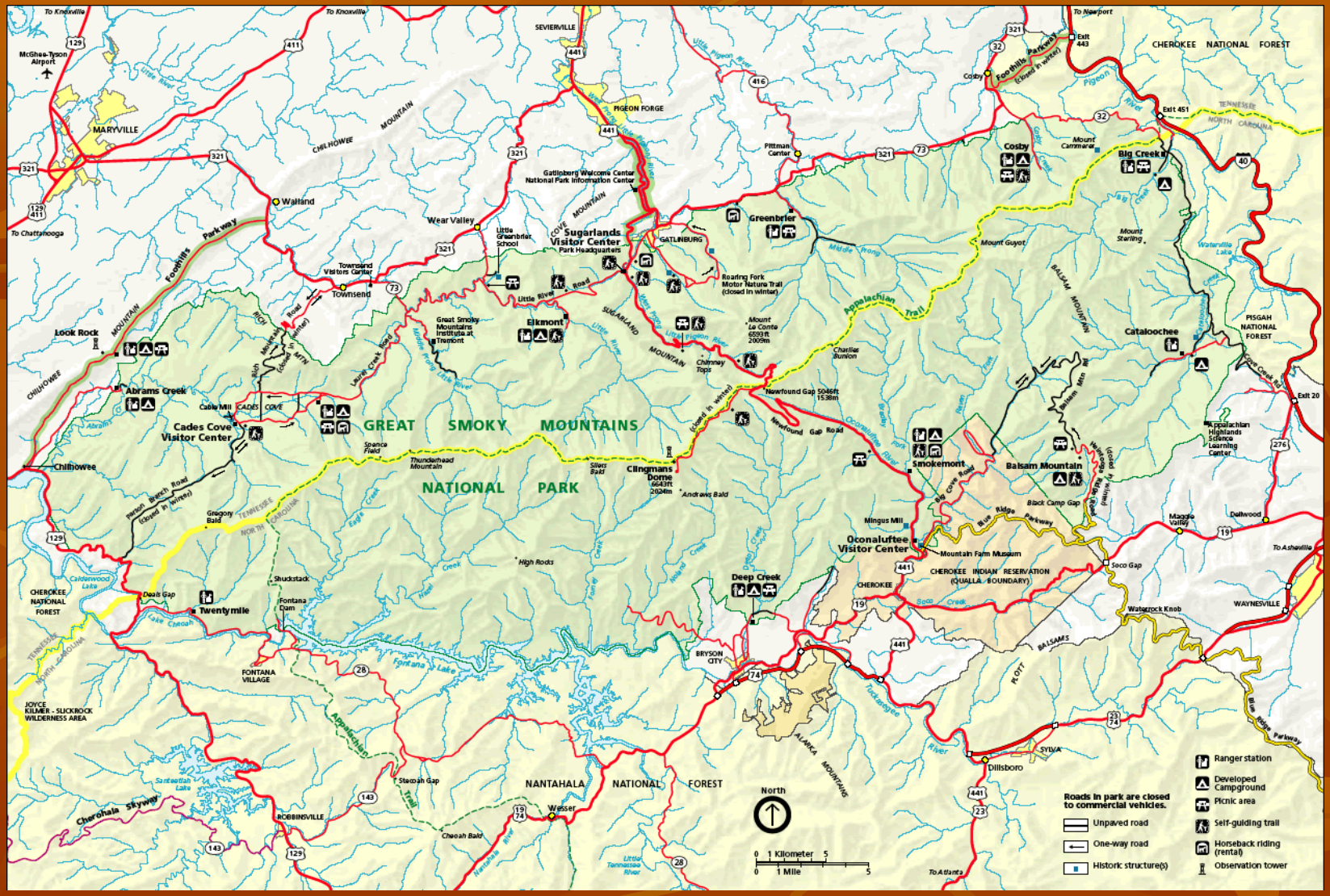
- Originally called Shaconage, “the place of blue smoke” by the Cherokee
- Most Cherokees removed forcibly in the 1830s … Trail of Tears.
- Park land had to be purchased from private landholders … difficult process!

Park established in 1935 primarily to protect two forest communities:

Spruce-Fir Forest

Cove Hardwood Forest

The CCC built most of the trails in the 1930s & 1940s



72 miles of the 2100 mile Appalachian Trail passes through the Park.

It contains the highest point in TN

– Clingmans Dome (6,643 ft)

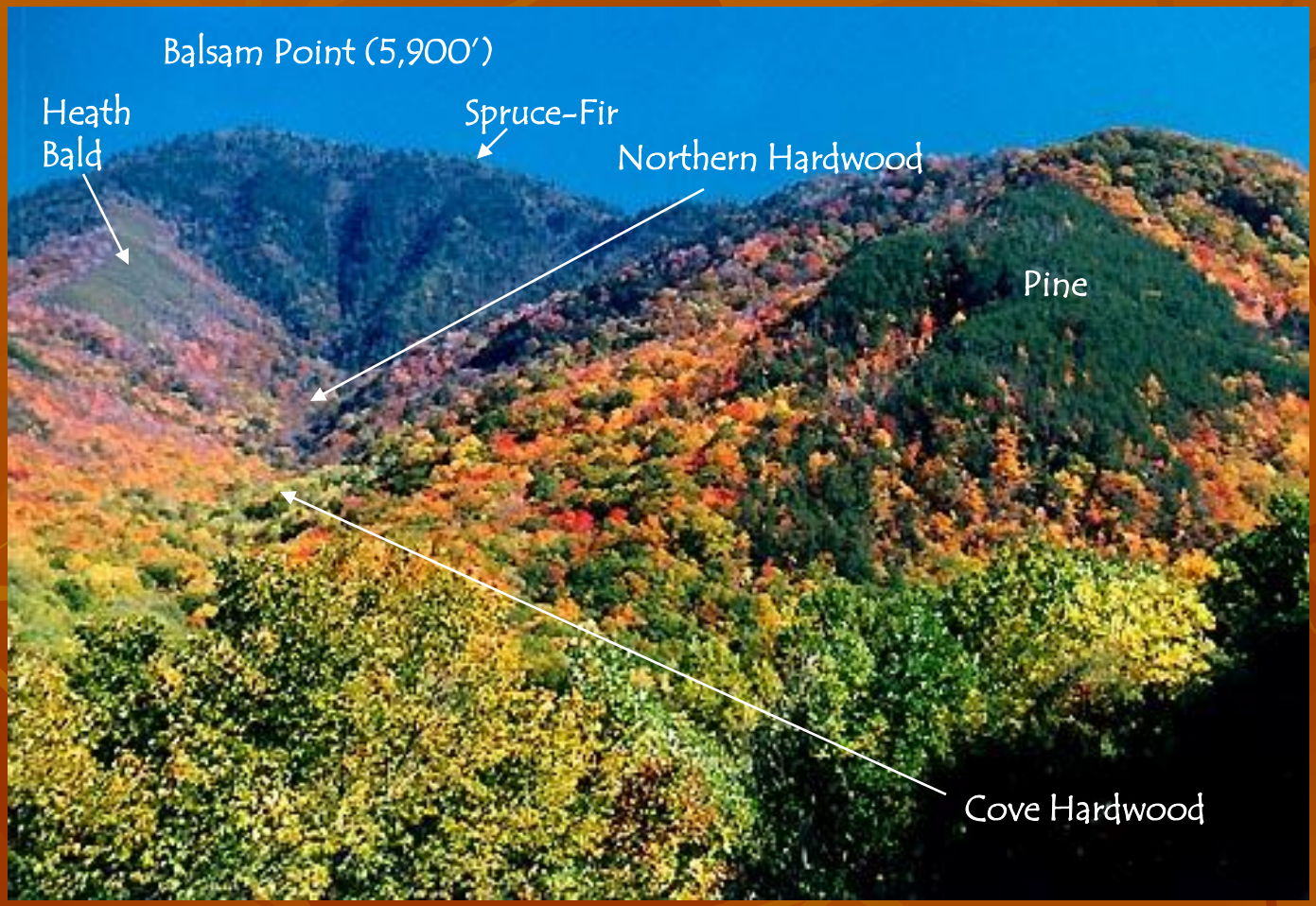
- Most visited park in America … over 11 million visitors annually!

- Called “The Range of Life” because of its tremendous biodiversity
- It contains over half million acres, most managed as wilderness
- U.N. designated the GSMNP as an International Biosphere Reserve

Current research … All-Taxa Biodiversity Inventory (ATBI)

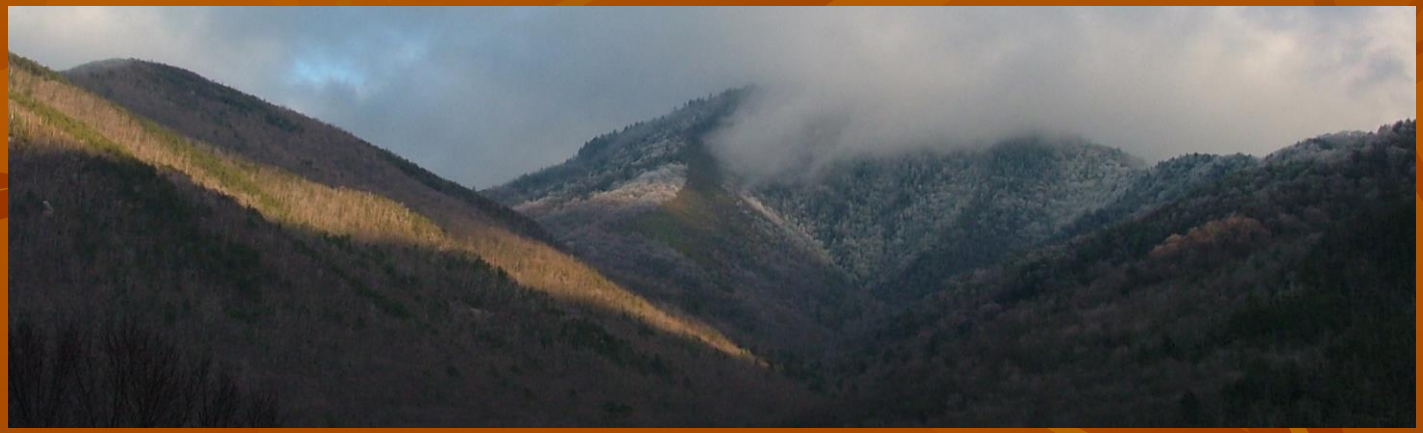
- Est. 100,000 species in park – greatest in all temperate zone
- Over the next 10 yrs scientists are attempting to classify all species
- Will provide baseline for future studies to determine effects of pollution, etc.
- More info at www.discoverlife.org/sc/

Smoky Mountain Forest Communities



View of Mt. LeConte from Campbell Overlook to the west.

SMOKY MOUNTAIN FOREST COMMUNITIES



The three major abiotic factors that determine forest communities are…

1. *Temperature*
2. *Precipitation*
3. *Exposure*

Elevation Increase

Every 1,000’ elevation gain results in…

- Climate similar to 300-400 miles north
- 3-4 degree F drop in temperature
- Increased precipitation
- Increased exposure to wind

Climate Comparison Due to Elevation Differential

Temperature – 40 F

Gatlinburg, TN (2,000 ft)

Temperature – 24 F

Mt. LeConte Shelter (6,000 ft.)

Exposure Factors

- North facing slopes receive limited sunlight …

  = very moist and cool
- South facing slopes receive maximum sunlight …

  = warm and dry

Smoky Mountain Forest Communities

- I. Spruce-Fir Forest

  With Grassy Bald & Heath Bald Sub-communities
- II. Northern Hardwood Forest

  With Beech Gap Sub-community
- III. Cove Hardwood Forest
- IV. Hemlock Forest
- V. Pine-Oak Forest

I. Spruce-Fir Forest

Glaciation's Diverse Legacy:

- **Continental glaciers** *did not get this far south, but cold ice age climates pushed northern plants and animals far south of their former ranges.*
- *When the climate warmed, these* **boreal** *species persisted in the cooler mountains on the spine of the Smokies.*
- *This ice age legacy adds remarkable biological* **diversity** *to the park.*

Extent of North American Continental Glaciers

Smoky Mts.

- Elevation: 4,500’ and up
- Climate: Simulates the climate of Southern Canada
- Precipitation: 85+ inches yearly, almost rainforest-like climate
- High snowfall possible; super-storm of 1993 = 6’ in 24 hrs

Fraser fir (*Abies fraseri*)

- Needles flat in cross section, rounded tips
- Cones erect on branches
- Balsam sap form blisters on tree bark

Red spruce (*Picea rubens*)




- Needles square in cross section, sharp pointed tips
- Cones pendant on branches
- Bark scaly and dark

Miscellaneous:

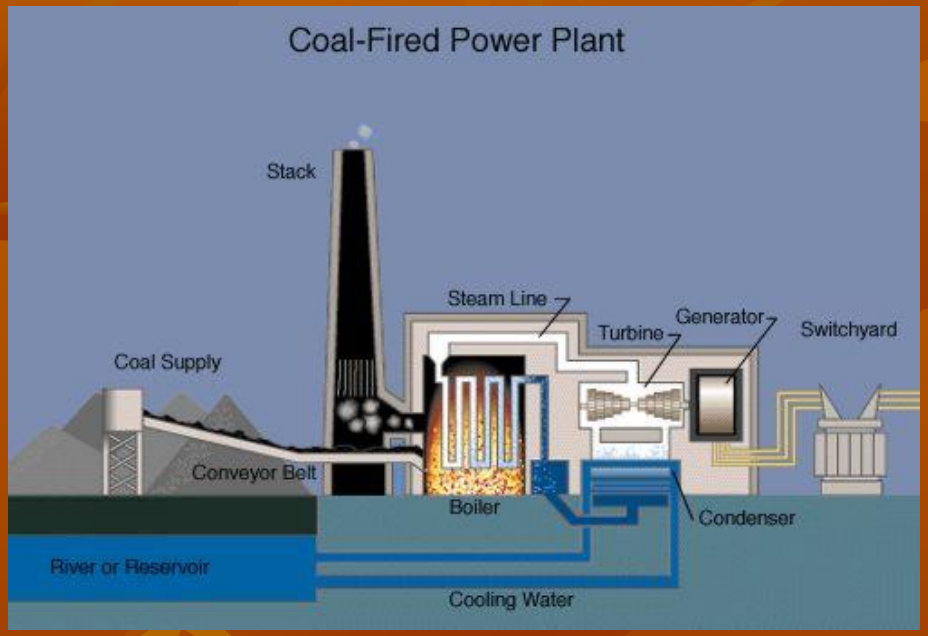
- Shallow acidic soils – the result of conifer needle decay and high precipitation
- Fibrous root systems created by spruce and fir trees.
- Lots of dead and downed trees – very slow to decay

Prop-stilt roots- visible evidence of a former nurse log that has decayed away

Old Man’s Beard is a light-green hairy lichen that hangs from tree limbs.

The Common Raven and Dark-eye Junco are year-round residents here.

Environmental Threats
Human Impact

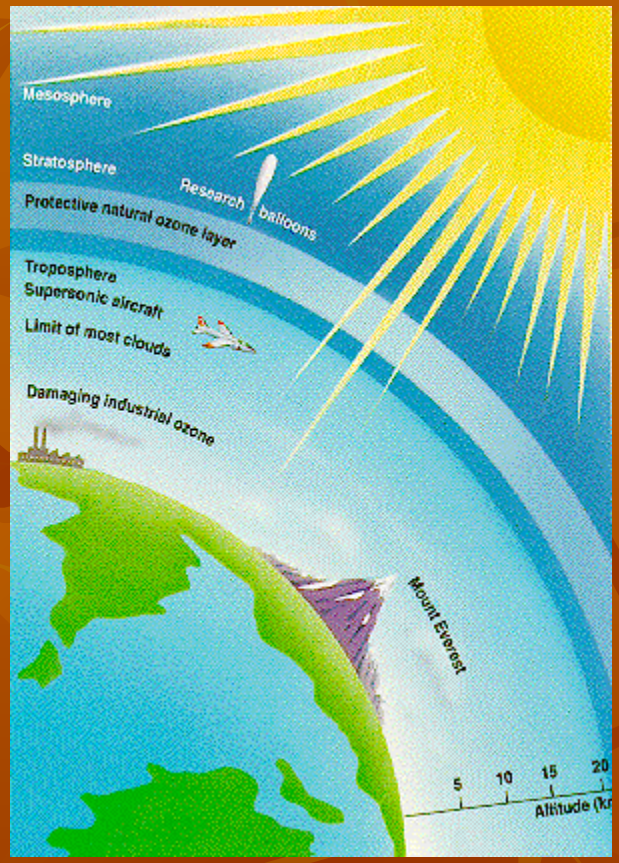


Air pollution blows in from coal-fired power plants and industry to the west.

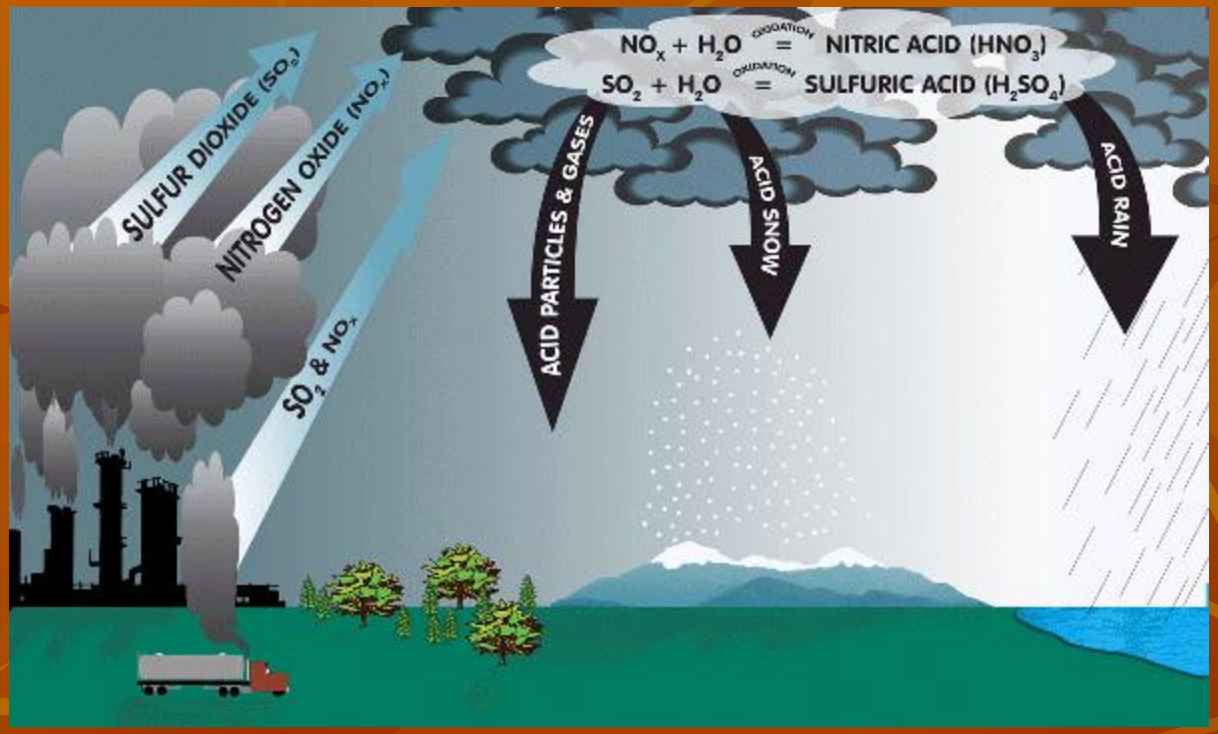
This results in…

1) Reduced visibility which reduces our enjoyment.

Extreme ozone damage



2) High ground-level ozone which damages plants.



3) Acid precipitation damages plant roots and invertebrates

- ** Note – The Spruce-Fir Forest community is sensitive to acid precipitation because:*
- *1) The thin soil is already acidic from conifer needle decay and high precipitation.*
- *2) Underlying rocks (slate & shale) do not neutralize acid.*

Exotic Organisms

- The Balsam Wooly Adelgid (aphid), an exotic insect from Europe has killed almost all the mature Fraser firs in the park in less than 30 years. Organisms adapted to this tree and forest type have also declined.

GRASSY BALDS – *a subcommunity that merges with the spruce-fir forest*

- Within the spruce-fir forest community are grassy balds that are positioned on the southwestern exposure of a few high peaks and ridges. Grassy balds are probably not natural but at the same time no one seems to know their origin.

- In times past the nutritious oat grass covered balds where maintained by settlers grazing livestock. Because livestock are no longer allowed to graze within the park many of the balds are slowly reverting to tree covered peaks.

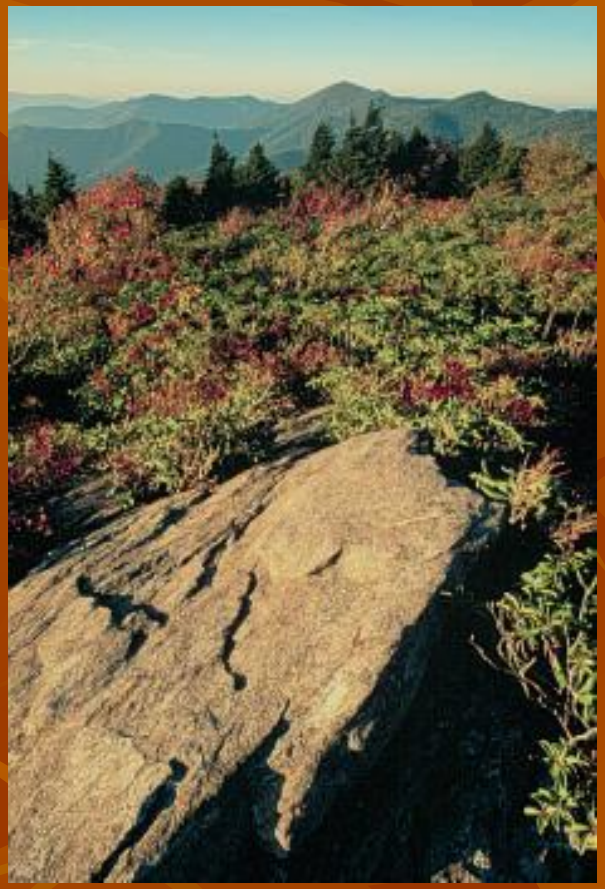
- To maintain the historic look these grassy balds, the park service periodically cuts down the encroaching trees on two of them, Andrews Bald (5,700 ft) and Gregory Bald (4,950 ft).

- Gregory Bald has the best display of Flame azaleas in the world during the last two weeks of June.

- One of the most common buteos in the Park, the Broadwing Hawk, can often be seen soaring over these scenic grassy balds.

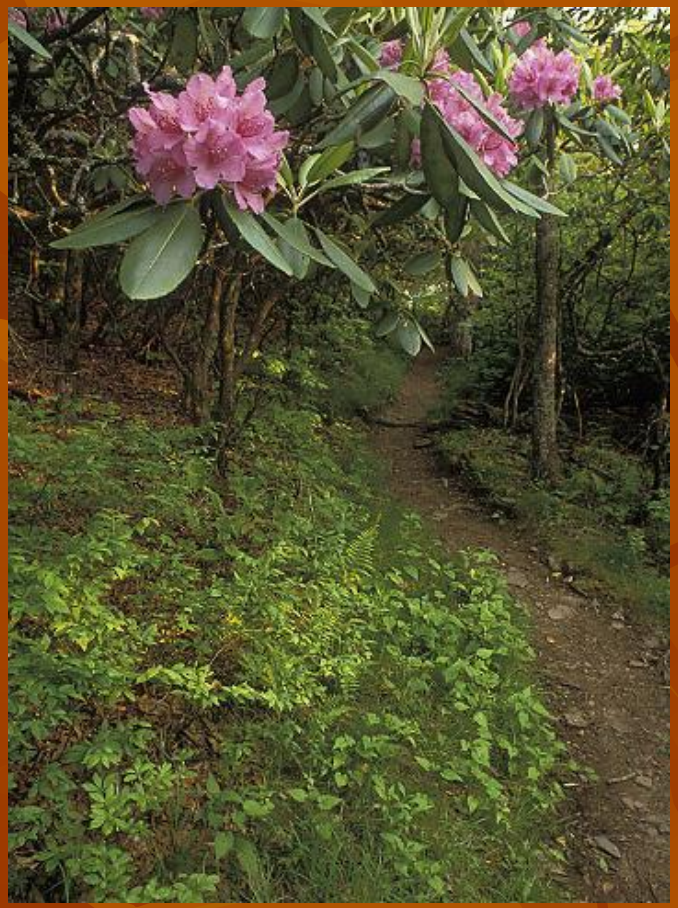
HEATH BALDS – *a subcommunity that merges with the spruce-fir forest*

- Many of the high ridges and peaks appear from a distance to look like smooth grass. Most often these balds are covered by impenetrably dense “hells” of Rhododendron and Azaleas, which are 10 to 20 feet tall. These can be easily seen on Mt. Leconte and the Chimney Tops.



Heaths eliminate most competing plant species by the following strategy:

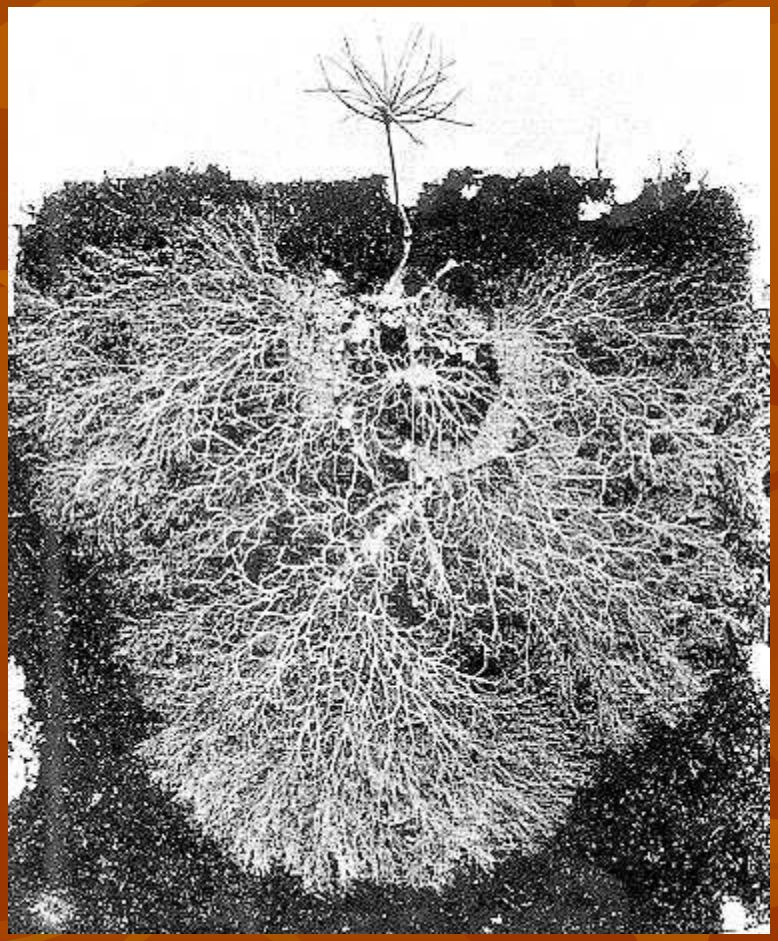
- Permanent shade – Their dense vegetation blocks out sunlight on forest floor
- Chemistry – Decomposing leaves make the soil acidic (pH 4.0-3.2) leaching out the nutrients



Heaths are in the Ericaceae family which also includes Mt. Laurel and Trailing Arbutus.

They can survive in this environment because of the following tactics:

- Vegetative propagation from root crowns allows plants to spread without seed germination.
- Mycorrhiza – a fungus/root symbiosis, enables heath to absorb sparse nutrients.



II. NORTHERN HARDWOOD FOREST

- Broadleaved trees adapted to high elevations make up this forest type. The northern hardwood forest often interrupts spruce-fir forests, growing at higher elevations than any other deciduous forest in the East.

- Elevations: Above 4,500 ft.

Environmental Threats

Human Impact: Same problems as in the Spruce-Fir Forest.

Exotic Organisms:

Beech bark disease is killing many of the American beech trees of the Beech Gap forest.

- In 1912 Wild Hogs were brought to a private North Carolina game preserve on Hooper Bald. They escaped in 1920 and by the 1940s they had spread into the park where, as elsewhere in the southern Appalachians, they have done extensive damage. In their search for roots, insects, etc. they till up the ground, foul springs, damage native plants and compete with native animals for beech, oak and hickory nuts. They are almost impossible to eradicate because sows can have 2 litters (up to 15 piglets per litter) in just one year!

BEECH GAPS – *a subcommunity of the northern hardwood forest that merges into the spruce-fir forest*

- An especially unique example of the northern hardwood forest is the Beech Gap. Beech gaps are pure stands of American beech trees growing in low spots on the south-facing slopes of high ridges. Set into spruce-fir forest, these distinct gaps look like islands of vegetation.

- The decomposing leaf litter results in soils that are allelopathic (pH of 4.5 and nutrient poor) which inhibits the germination of competing spruce and fir seedlings. In addition the soil has a characteristic “outhouse” smell.

- The red-cheeked salamander is endemic (found nowhere else in the world) to the beech gap forest.

III. COVE HARDWOOD FOREST

- Cove hardwood forests grow in sheltered valleys with deep, rich soils. Commercial loggers missed only a few of these valuable groves during their heyday back in the early 1900s. The cove hardwood forest is one of the most diverse forest communities in the world. The greatest numbers and diversity of hardwood trees and spring wildflowers grow here.

- Elevation:

  In coves and on sheltered slopes from 2,500’ – 4,500’

Gap-phase Succession

- Gap-phase succession occurs when fallen trees or loggers remove the forest canopy and opens-up the forest floor to sunlight.

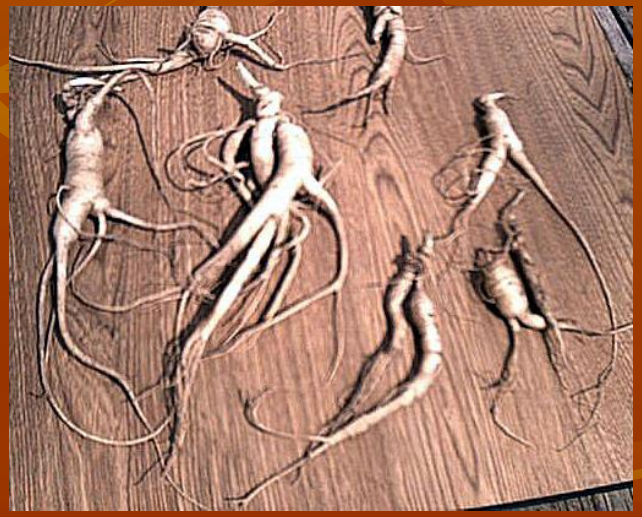
- The dominant trees indicating gap-phase succession are the fast growing sun-loving Tulip Poplar and Black Locust.
- Following in their wake will be seen large oaks, maples, magnolias, etc.

- The yellow birch can be found in this and other forest communities. A twig that has its' bark scraped off will smell like wintergreen.

Environmental Threats

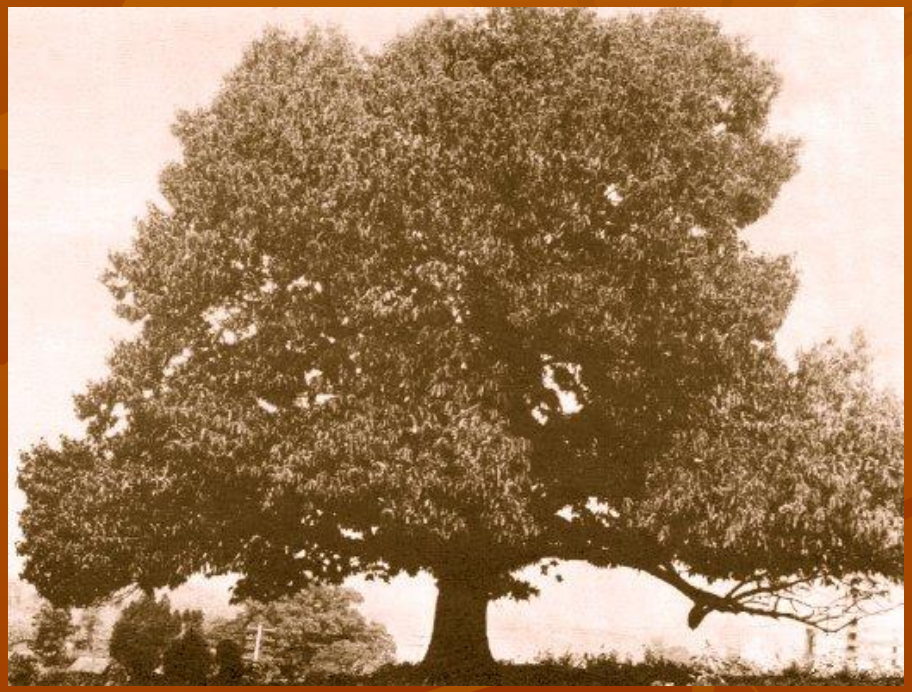
- <u>Human Impact:</u>
- Black bear: Poachers with guns, dogs, and traps illegally kill bears inside the park.
- Many are killed only for their gall bladder, considered an aphrodisiac in Asia.

- American Ginseng: Ginseng roots are dug and sold illegally for their supposed ‘vital’ nature and may be worth up to $500 per pound!

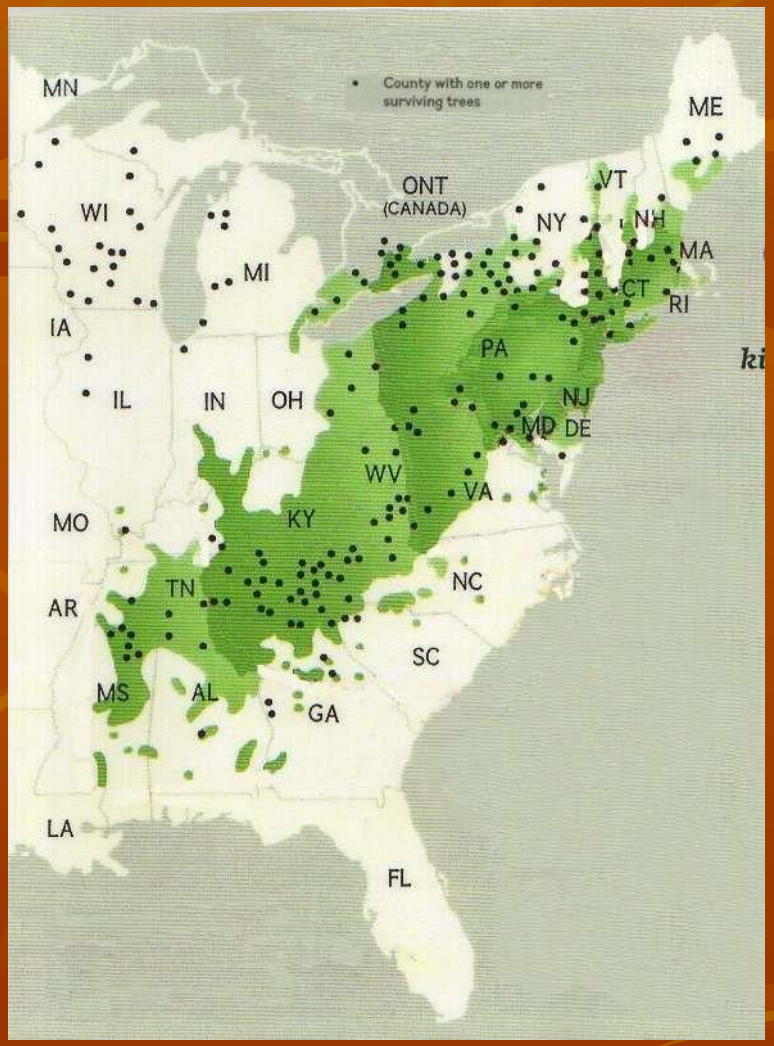


Exotic Organisms:

Chestnut Blight: A fungus disease, from the Oriental chestnut trees introduced to NYC early in the 20th century, wiped out the American chestnut tree by 1950. In former days it often made up to 25 percent of the eastern forests and supplied mast (nuts) for wildlife.



The American Chestnut today…



IV. HEMLOCK FOREST

- Evergreen hemlock trees, Great White Rhododendron, and Mountain Laurel dominate stream sides and shaded, moist slopes at lower elevations.

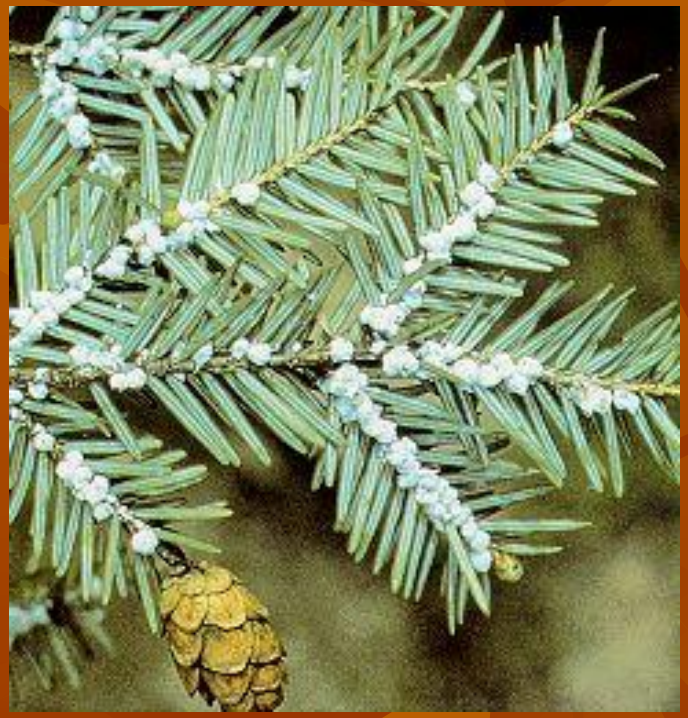
- At somewhat higher elevations Hemlocks and Catawba Rhododendron (most often found in heath balds) can be seen growing together on drier slopes and ridges.
- Elevation:

  Along streams up to 3,000 ft

  On dry, exposed slopes and ridges up to about 4,000 ft.

Environmental Threats

- <u>Exotic Organisms:</u>
- Hemlock wooly adelgid: Introduced from Asia, this aphid has begun to damage many mature hemlocks.



- Rainbow and Brown Trout: These introduced species have displaced most of the native Brook trout. Efforts are being made to restore native Brook trout.

Gypsy Moths

- Native to Europe and Asia, gypsy moths were brought to Massachusetts from cross-breeding with silkworm moth in the 19th century.
- Some larva escaped, and gypsy moths have now defoliated much of the eastern hardwood forest lying between the park and New England. They are now an imminent threat to the park's forest.

PINE-OAK FOREST

- Where dry slopes are heavily exposed to direct sunlight (open canopy), oak or pine-and-oak forests predominate at the lowest elevations. Both forest types include rhododendron and mountain laurel thickets and yellow poplar, hickory and flowering dogwood trees.

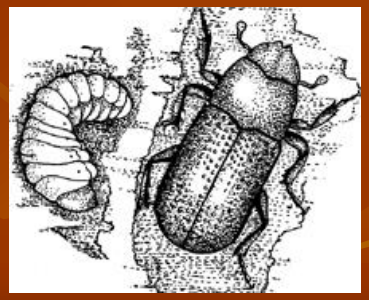
- These are the forest types we find most commonly in the smaller mountains of the southern Appalachians (around Chattanooga).
- This is the most likely habitat to find Pink Lady Slipper Orchid blooming.
- Elevation: On dry exposed slopes (south facing) and ridges up to about 4,500’

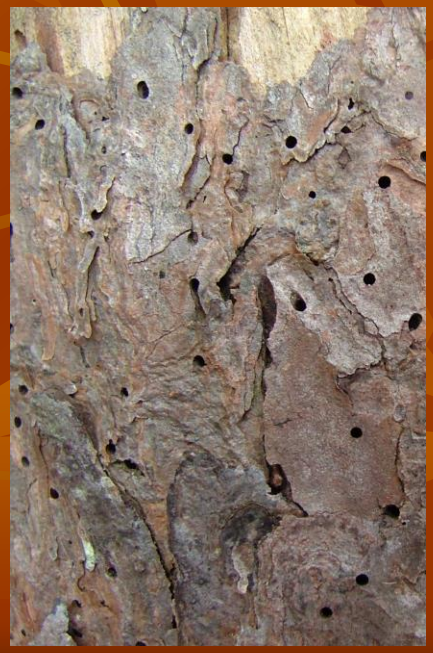
Environmental Threats

- Exotic Organisms:
- Dogwood Anthracnose Fungus: Flowering dogwood trees are dying off.

Results of Fire Suppression:

- Southern Pine Beetle Population Explosion: Orange needles on pine trees may indicate infestation by indigenous (native) southern pine beetles.

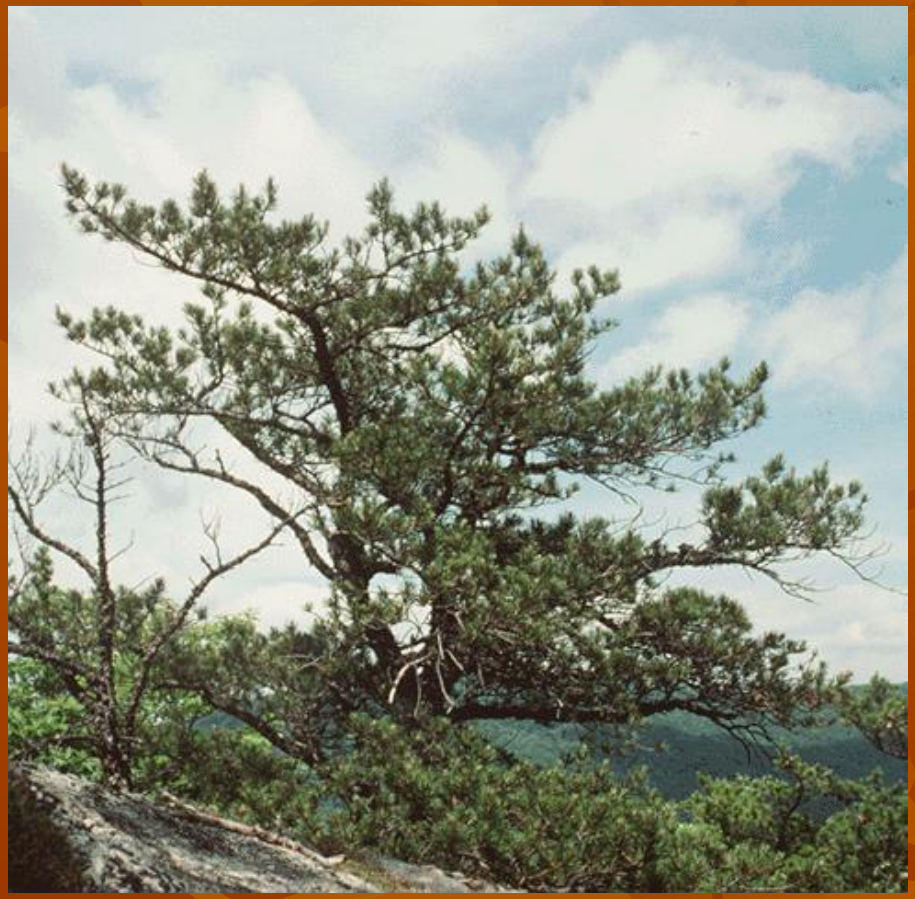




- If fire is suppressed, the pine beetles increase, and impacts of their predation multiply.

- Without periodic fire, hardwoods replace the pine forest, which means more beetles prey on fewer pines. This double squeeze on pine forests affects species adapted to live in them, such as the threatened Red-cockaded woodpecker that nests in live pines.

- Some pines such as Table Mountain Pine require fires to open their serotinous cones.



CADES COVE REGION and WHITE OAK SINK

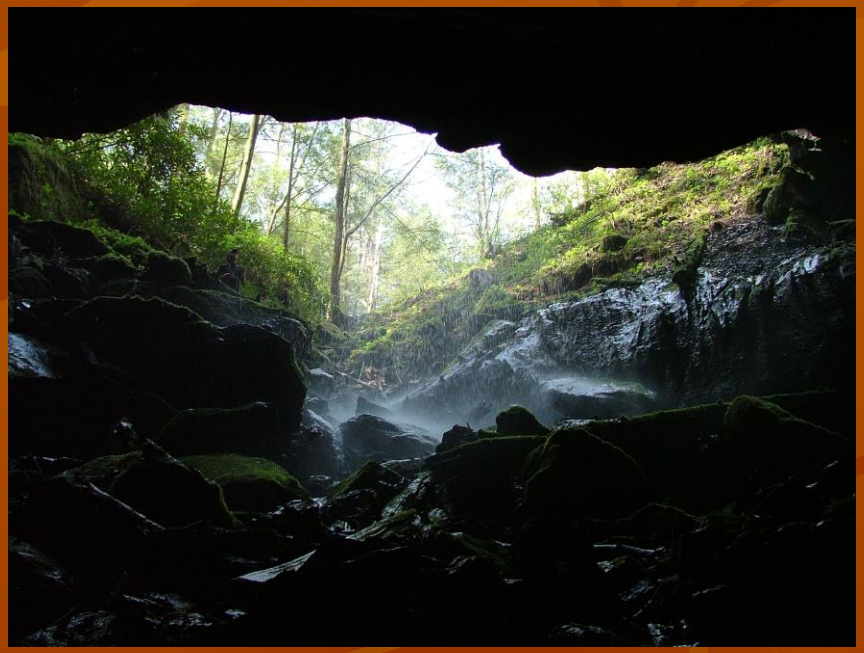
Geology of Cades Cove and White Oak Sink

- This area is part of the Smoky Mountain overthrust, with valleys (or coves), floored with limestone, appearing as “windows” through the overlying Precambrian rocks.

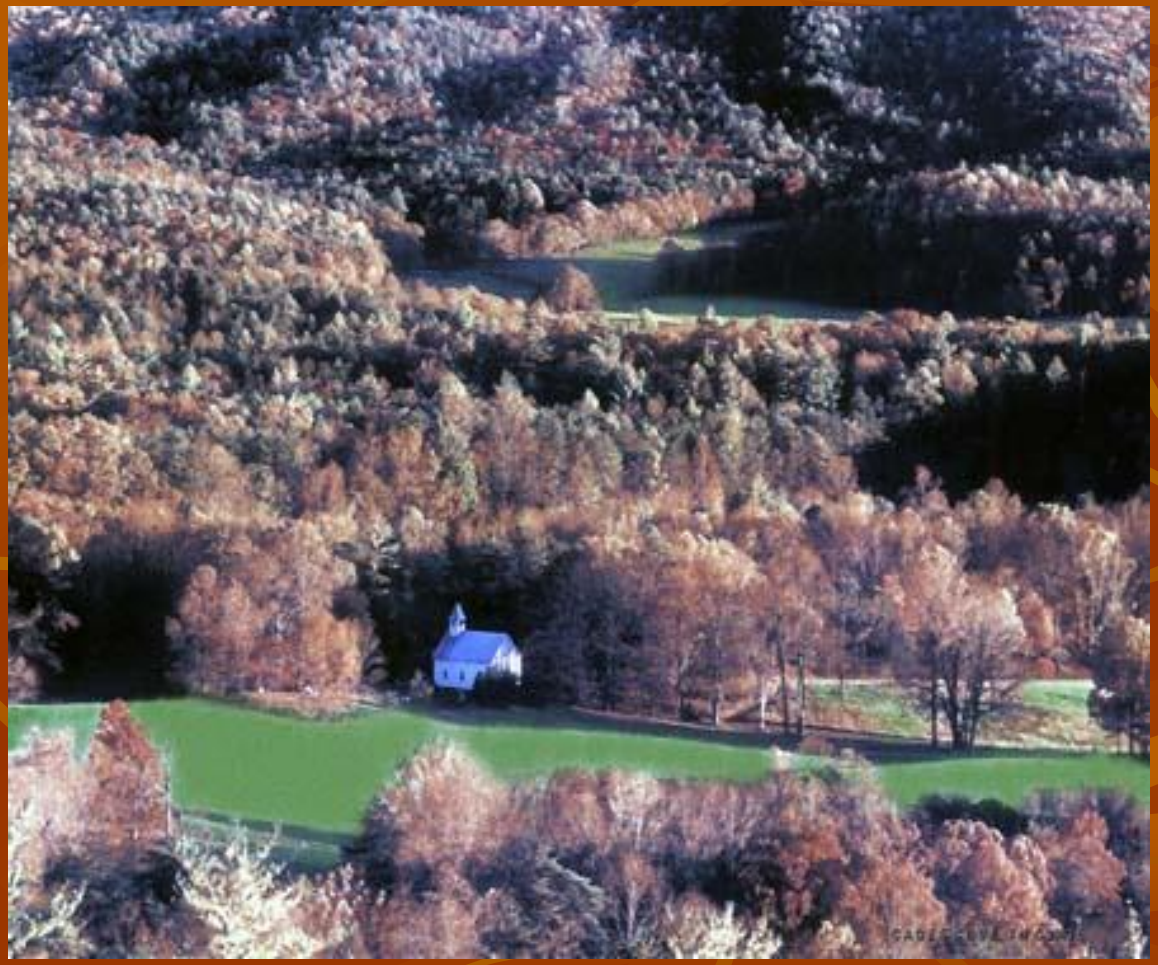

Great Smoky Fault
Dunn Creek Fault
Great Smoky Fault
Great Smoky Fault
Miller Cove Fault
Walland
Wear Valley
Great Smoky Fault
Townsend
PIGEON FORGE
Gatlinburg Welcome Center
National Park Information Center
GATLINBURG
Pittman Center
Greenbrier
Gatlinburg Fault
Sugarlands Visitor Center
Park Headquarters
Laurel Falls Trail
Laurel Falls
Little River Road
The Sinks
Elkmont
Great Smoky Mountains Institute at Tremont
Oconaluftee Fault
Grotto Falls
Rainbow Falls
Alum Cave Trail
Newfound Gap Road
GREAT SMOKY MOUNTAINS
Abrams Falls
Cades Cove
Cades Cove Visitor Center
TENNESSEE
NORTH CAROLINA
Clingmans Dome Trail
1
2
3
4
5

These limestone “windows” are characterized by:

- Karst – limestone rock full of cavities created by rainwater over time.
- Streams that disappear into caves and sink holes.
- Rich sweet soils (not acidic) that nourish luxuriant vegetation.



History of Cades Cove and White Oak Sink



Native Americans:

- Part of the territory once ruled by Old Abram of Chilhowee, a famous Cherokee chief.
- Both Abrams Creek and Abrams Falls are named after him.

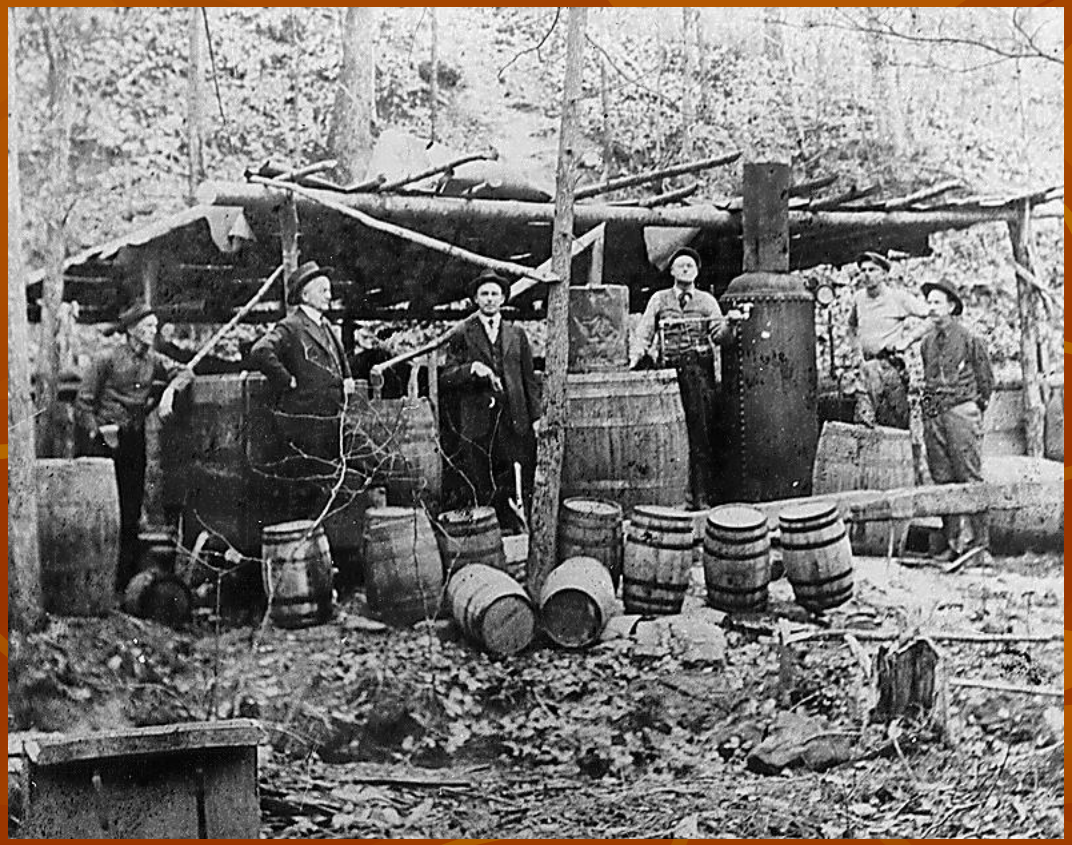
- Tradition holds that the cove itself is named after Old Abram's wife, Kate … Kate's Cove … Cades Cove!
- Indian Treaty of 1819 ceded the lands away from the Cherokee.

White Settlers:

- John Oliver – first white settler entered the cove in 1818
- Dominant family names of Cades Cove – Tipton, Shields, Lawsons, Cables, and Gregorys

- The rich soil soon supported a thriving agricultural community with 3 schools and several churches.

Julius Gregg – operated the largest industry, a distillery, until 1886, when it was outlawed in TN.



- Early 1920s Cades Cove supported between 90 and 100 families – about 600 people.
- Some of their descendents still lease the land from the park service to preserve the cove and its heritage.

- Although the first generation had lived well on the rich soil of the bottomlands, the second and third generations were squeezed out and some ended up in White Oak Sink.

White Oak Sink Today ….

- We think that the White Oak Sink is a beautiful gem of God's creation. It is yours to enjoy today and in the future.

- To ensure that others will enjoy its beauty in the future it is essential that YOU please adhere to the following rules.

- *Stay with the group at all times and listen attentively when the leader is talking.*
- *Stay on the trail to prevent trampling of fragile plants.*
- *Do not pick any flowers or pull up any plants.*
- *Be observant and ask intelligent questions.*
- *Feel free to take pictures but don't lag too far behind.*
- *Keep a careful list of all the plants you see!*