An Approach to Assessing if Nutrient Base Cations May Be Sufficient for Healthy Spruce-fir Forests

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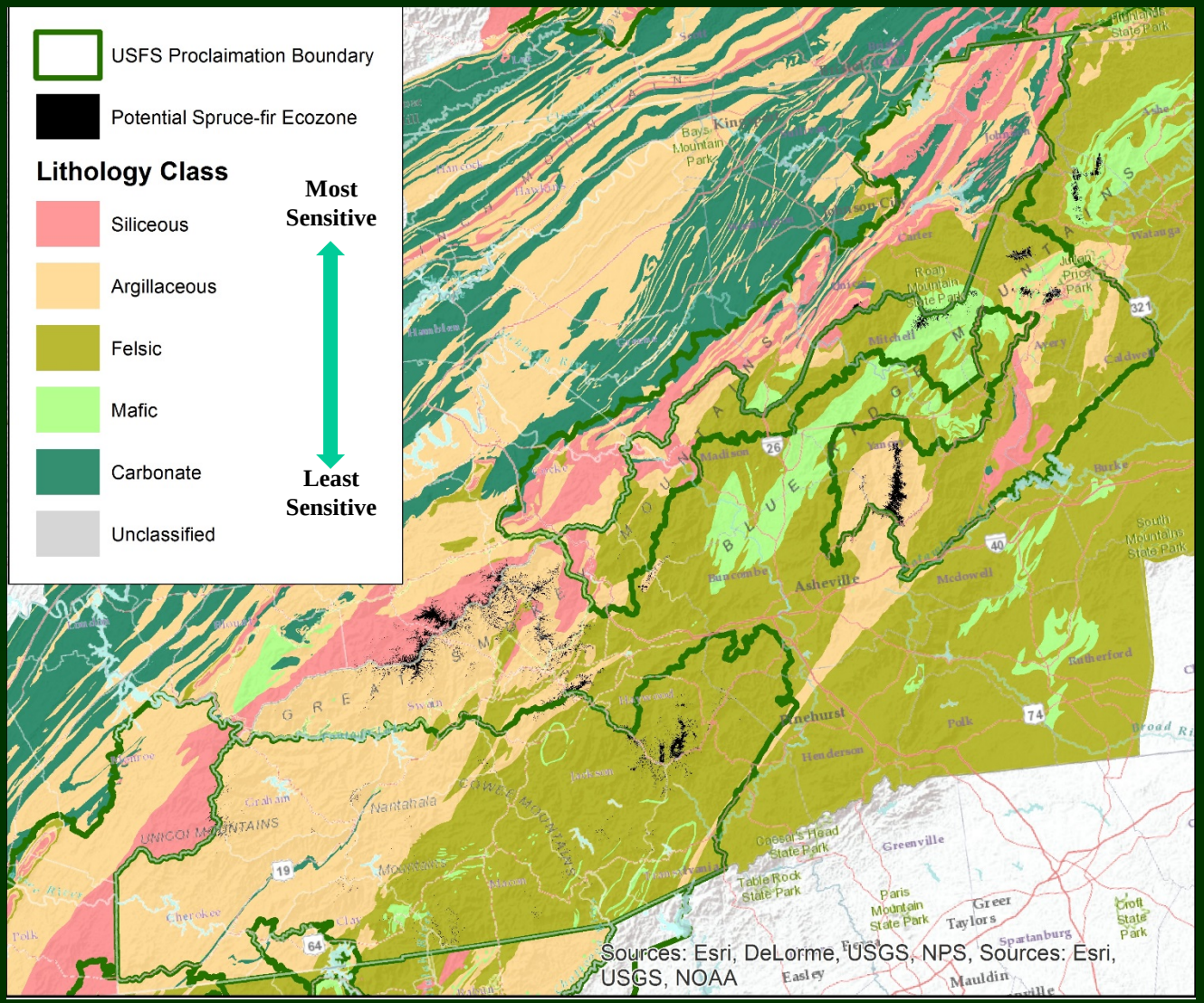
Why Are Nutrient Base Cations Important?

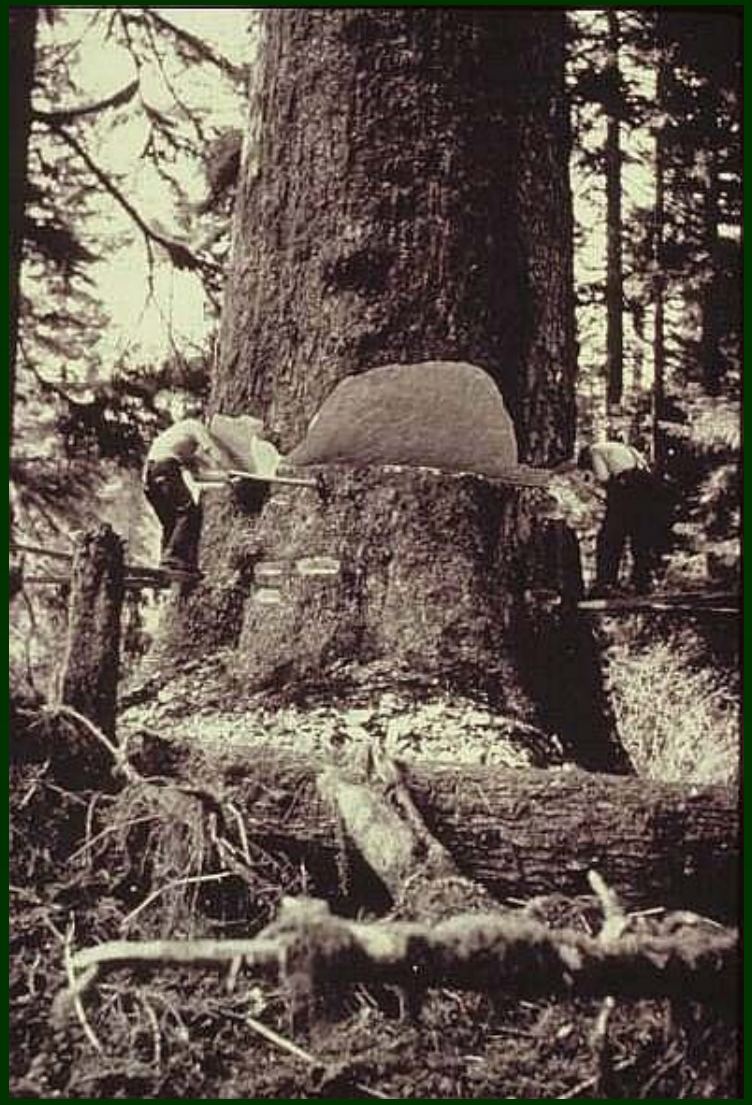
- Calcium (Ca^{2+}): cell walls and increase wood production, cold tolerance
- Magnesium (Mg^{2+}): photosynthesis
- Potassium (K^{+}): maintain cell pressure, cell expansion, and stomatal movement

Managing for healthy and resilient forests

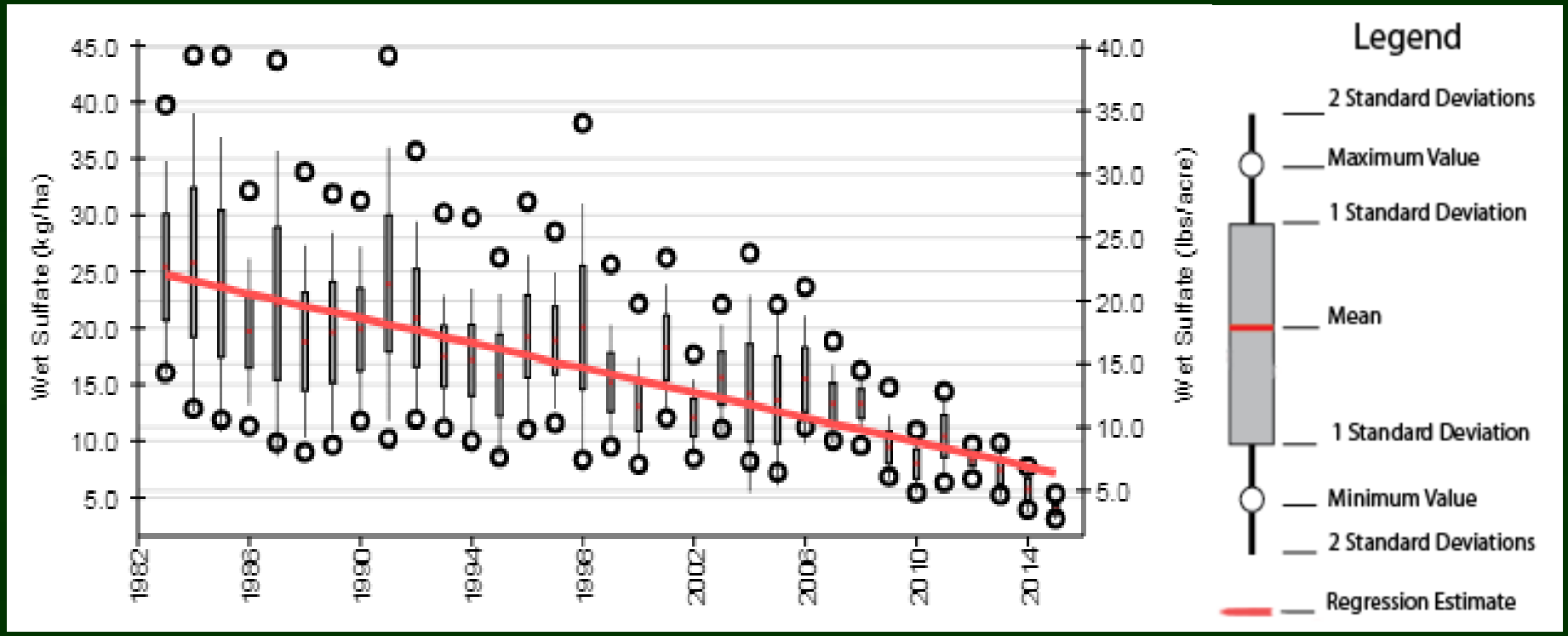
Influences - Geology



Influences – Land Use

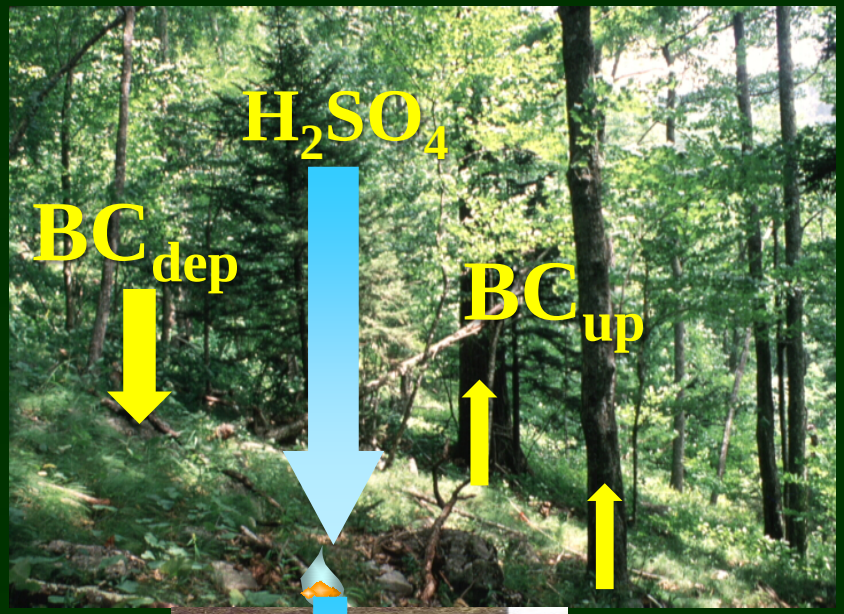


Influences - Deposition



Nutrient Cycling

Base Cations (BC) = calcium + magnesium + potassium + sodium



Timber harvesting does remove base cations.

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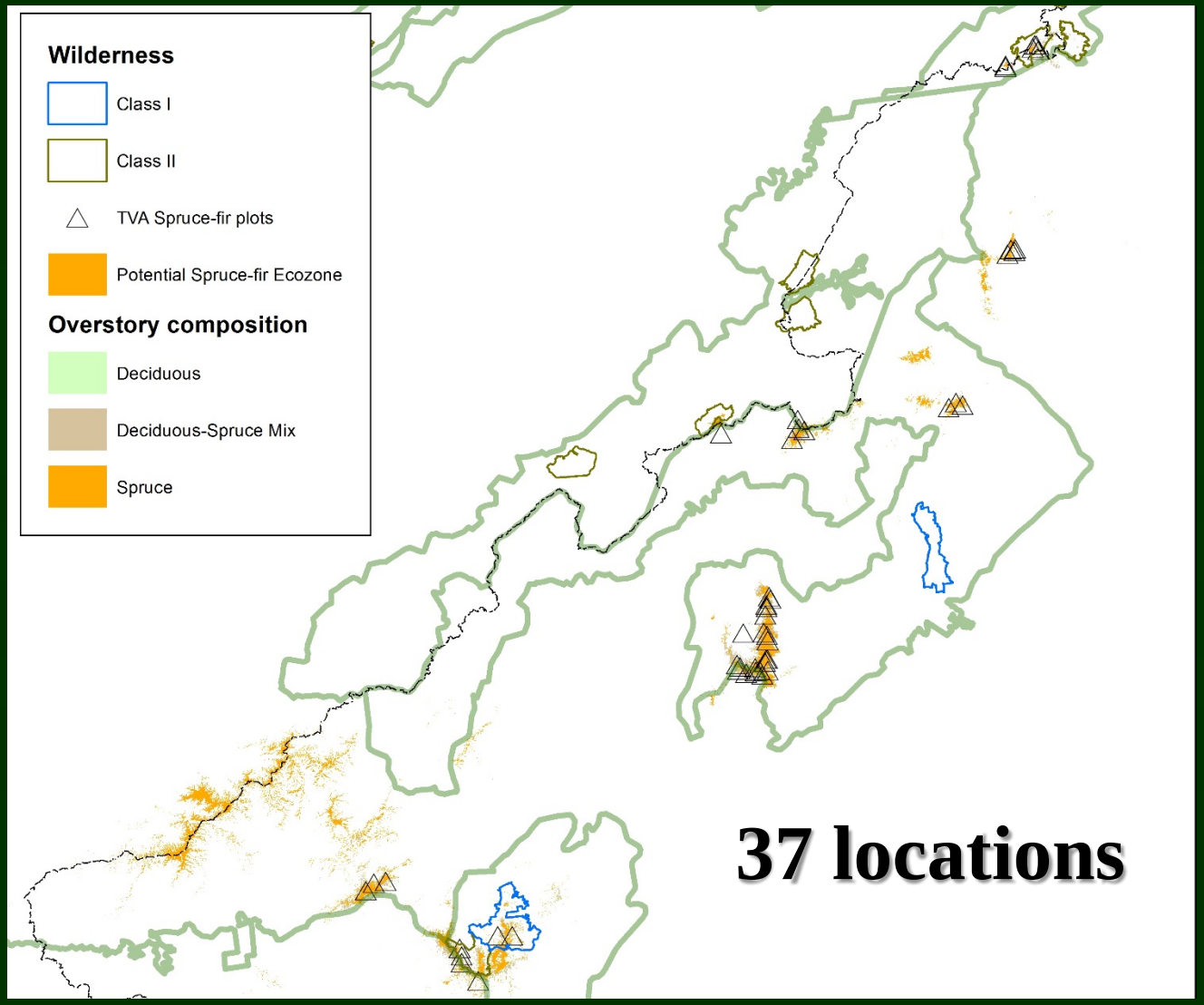
Resample TVA Spruce-fir Plots



Resample TVA Spruce-fir Plots

- First sampled in 1984 – 1985 by TVA scientists
  - Dr. J. Michael Kelly and Paul Mays (retired)
- Resampled in 2013 and 2014 by Coweeta staff
  - Dr. Jennifer Knoepp

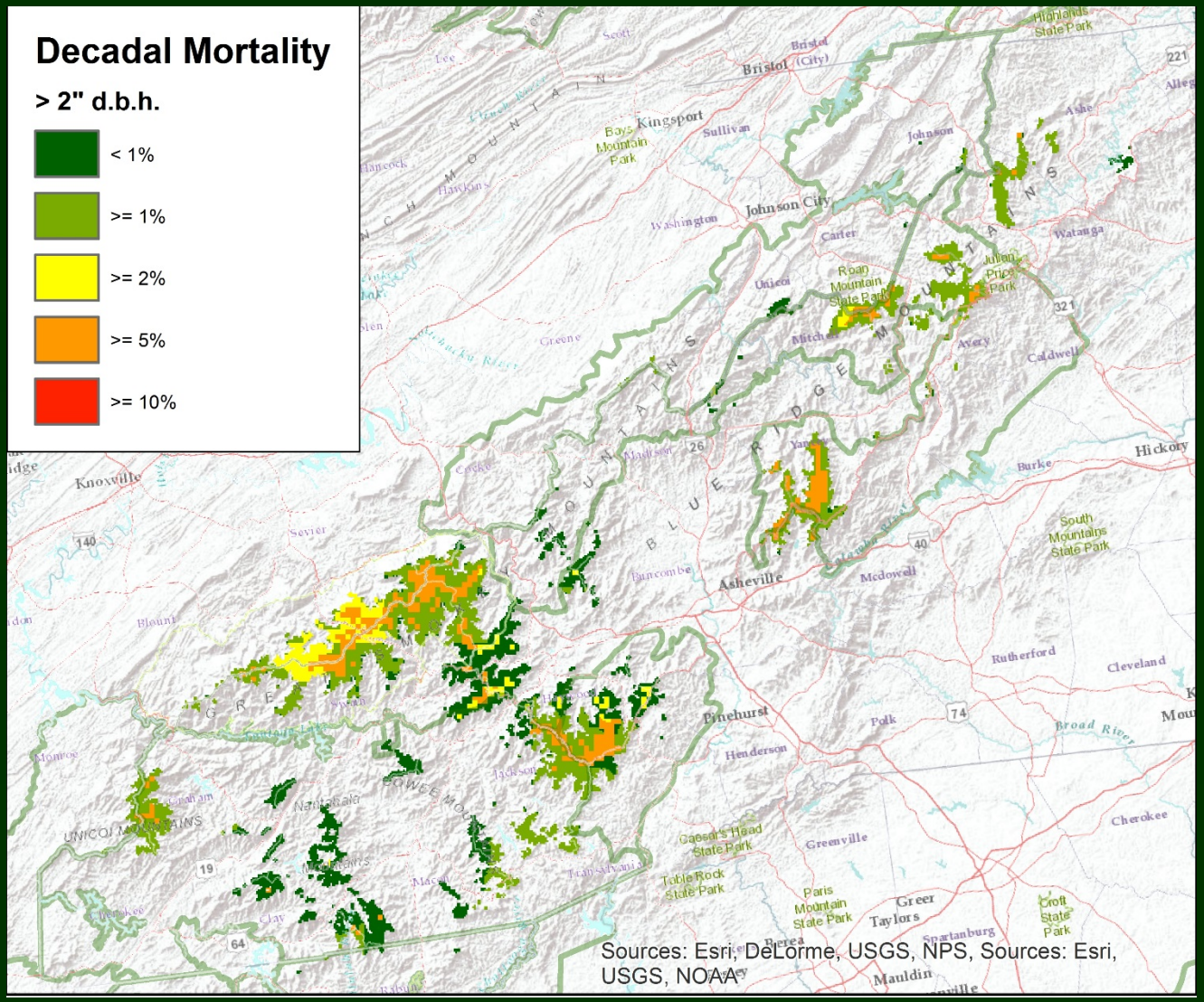
Purpose

- Evaluate effect of declining SO_4 inputs due to CAA 1990
  - Recovery or decline of spruce and fir populations
  - Improvement in soil chemical quality, measurements include:
    - Soil adsorbed sulfate
    - Exchangeable base cations
    - pH
    - Al

Tree species critical loads for the US

- Lead: Kevin Horn and Quinn Thomas (VA Tech)
- Goal: To develop critical loads for individual tree species.
- Data and data processing:
  - >100,000 plots nationally using the FIA P1/P2 plots resampled in 2000-2014.
  - Filtered out managed forests
  - > 2000 plots per species → 94 spp.
  - Data for mean annual temp and precip (PRISM), and N and S dep (TDEP) linked to plot locations.
- Analysis:
  - 2 responses: growth, survival
  - Base model: modified lognormal functions of height, temperature, precipitation, height, size (power).

Red Spruce Mortality - Sulfur



Mortality estimates based upon the mean 2013-2015 total deposition (rain + dry + cloud).

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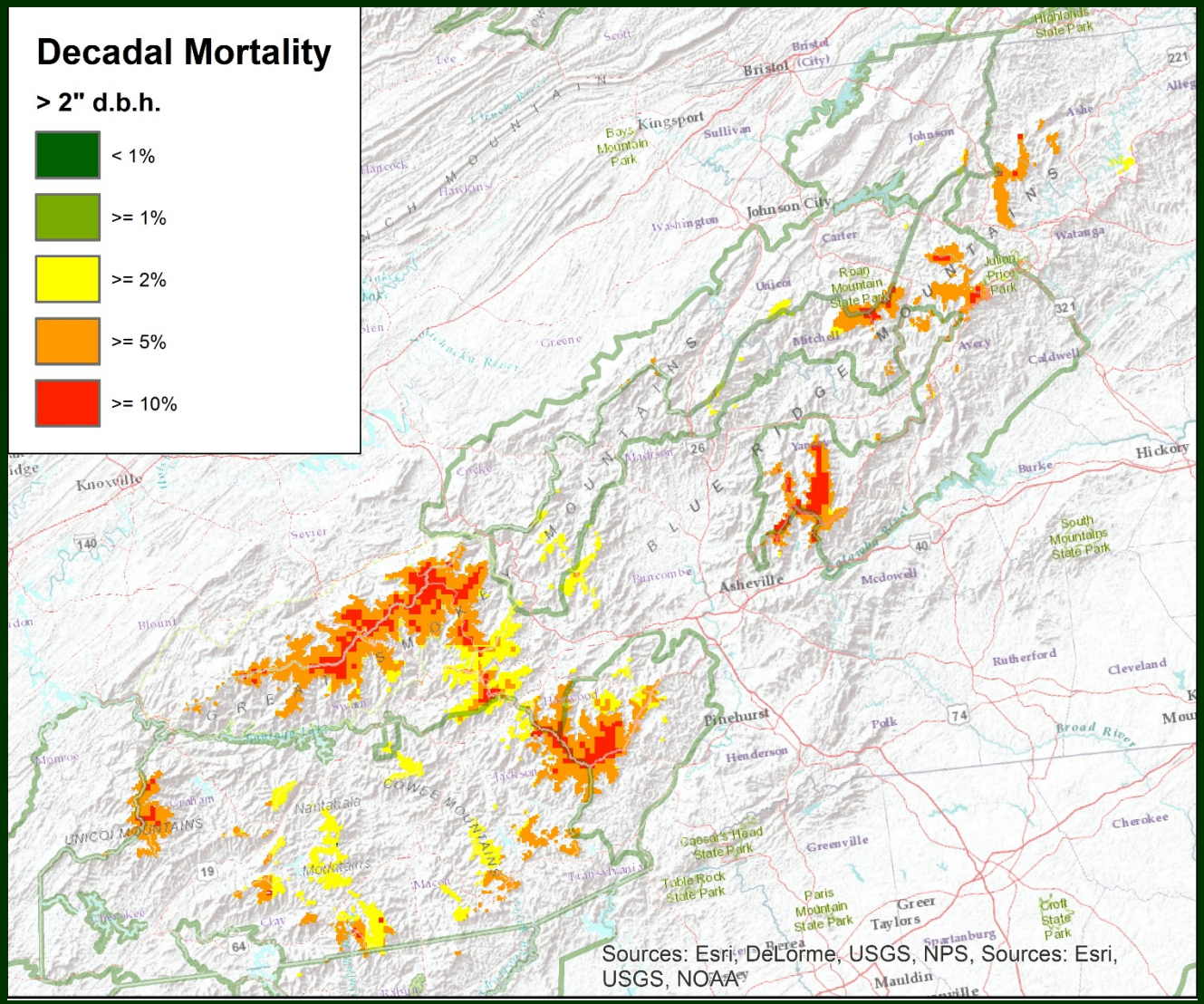
Red Spruce Mortality - Nitrogen



Mortality estimates based upon the mean 2013-2015 total deposition (rain + dry + cloud).

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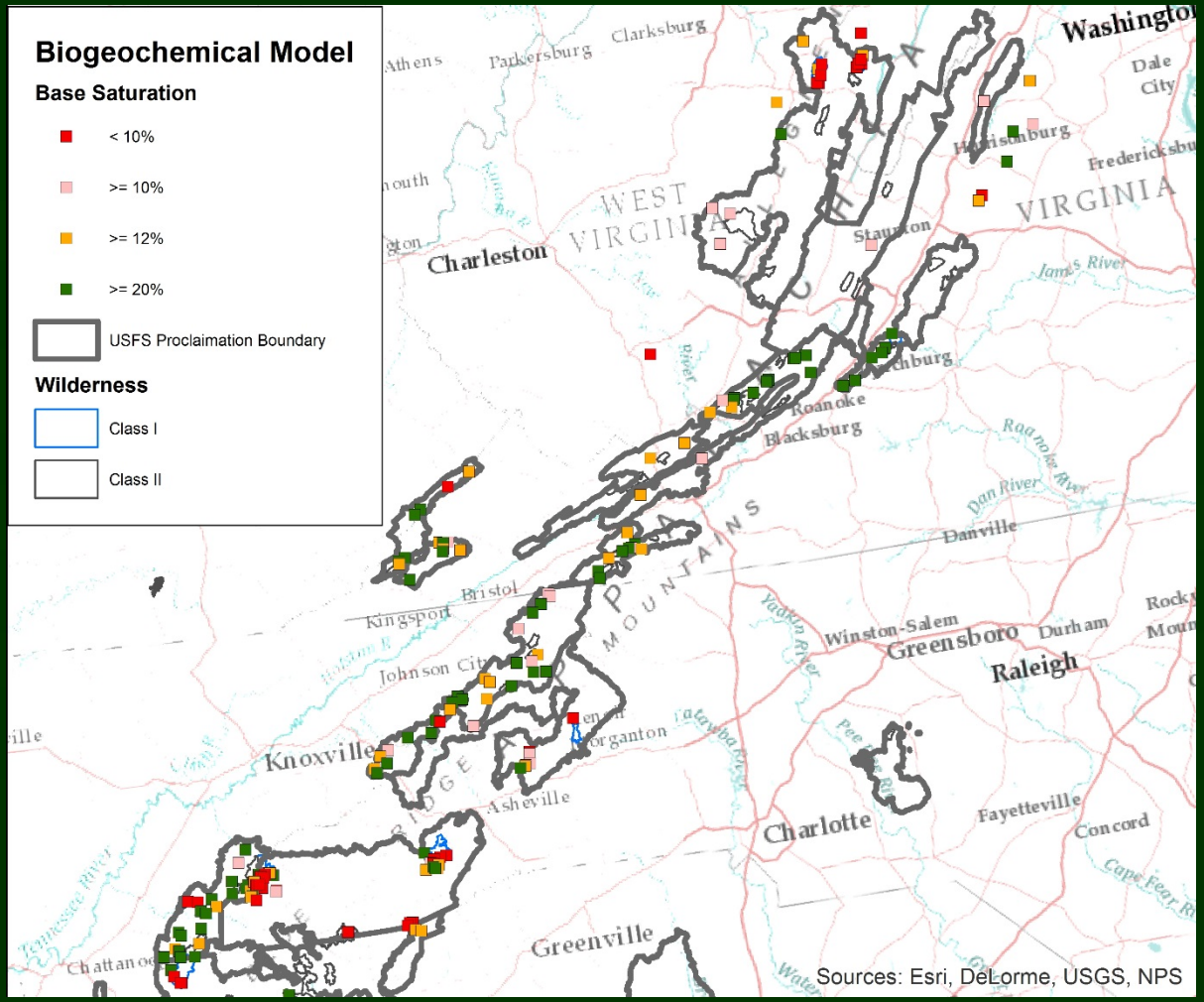
Soil and Water Samples Used in MAGIC



MAGIC = Model of Acidification of Groundwater in Catchments.

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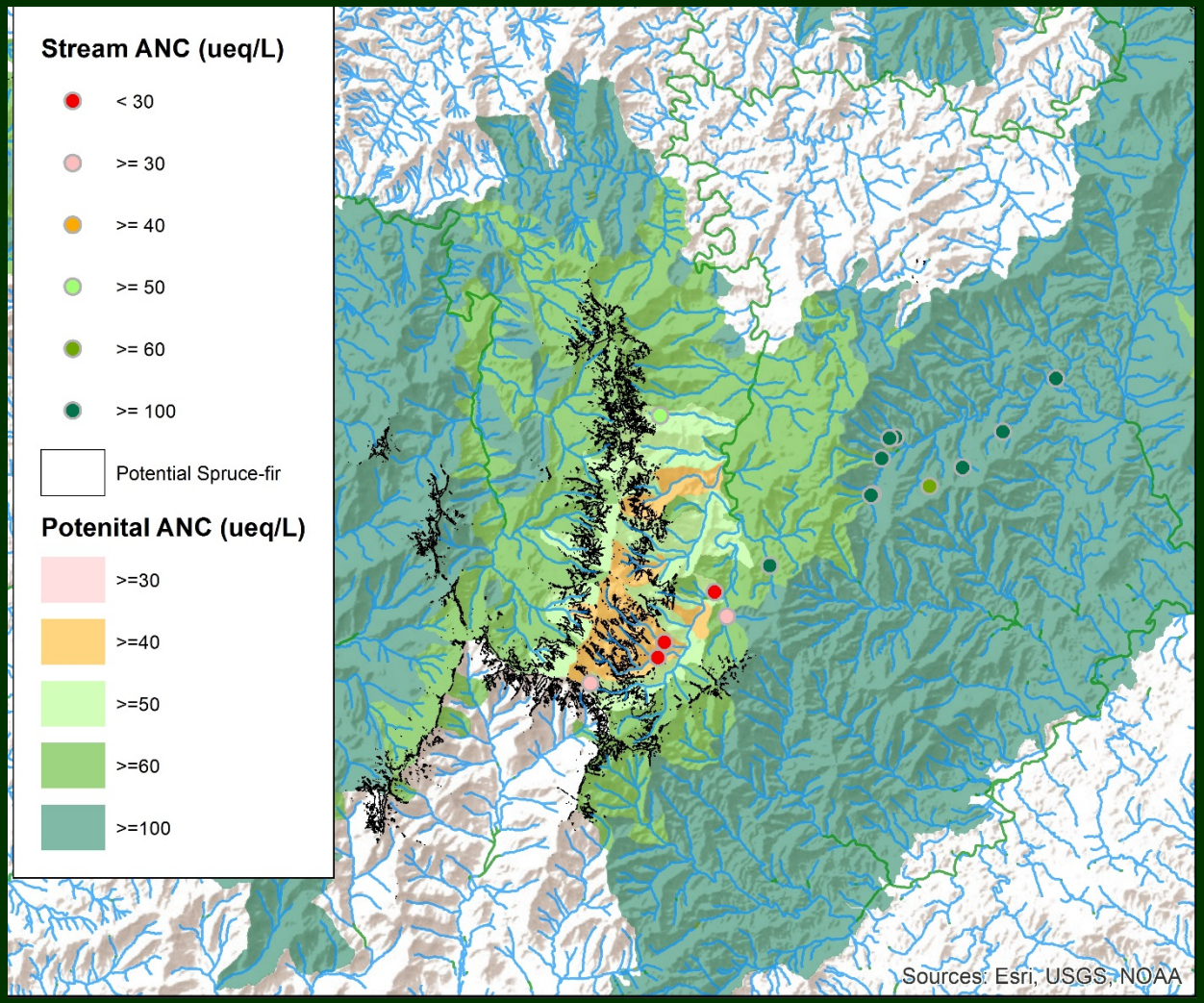
Using Stream ANC

Black Mountains



Site Indicators of Risk

- Stream
  - Acid neutralizing capacity (ANC) is less than potential

    ANC = Base Cations – Acid Anions

    Acid anions are: sulfate, nitrates and chloride

- Soil or Soil Water
  - Percent base saturation
  - Calcium to aluminum ratio
  - Total calcium
  - pH

Discussion

- Should we be gathering site specific information, such as soil chemistry data?
- If the area to be planted has a low amount of base cations, or there may be acidity impacts, then should we consider applying lime?
- Should we increase the planting density to account for decadal mortality associated with sulfur and nitrogen deposition?

http://webcam.srs.fs.fed.us

USDA United States Department of Agriculture
Forest Service

Air Resource Management
Region 8 and 9

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- Tools

Contact Information

- Region 8 Contacts
- Region 9 Contacts

Why do we monitor air quality and visibility?

Monitoring the air quality within and near the National Forests in the Eastern (Region 9) and Southern (Region 8) Regions is one example of how the Forest Service is "caring for the land, and serving people." The air quality monitoring information is used for environmental assessments, and for our forest planning for each National Forest in the Eastern and Southern Regions. Furthermore, the Region 8 and 9 Air Resource Management staff use the information when providing technical advice to the appropriate Forest Supervisor (designated as the Federal Land Manager according to the Clean Air Act Amendments of 1977) when a new (large) stationary source of air pollution has the potential to impact any Air Quality Related Value at one or more of the 17 federally mandated **Class I areas**.

Webcams:

Joyce Kilmer

Shining Rock

Upper Buffalo

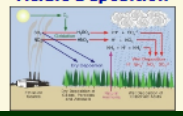
Boundary Waters

Dolly Sods

Presidential Peaks

Air Pollutants of Concern:

Acidic Deposition



Ozone