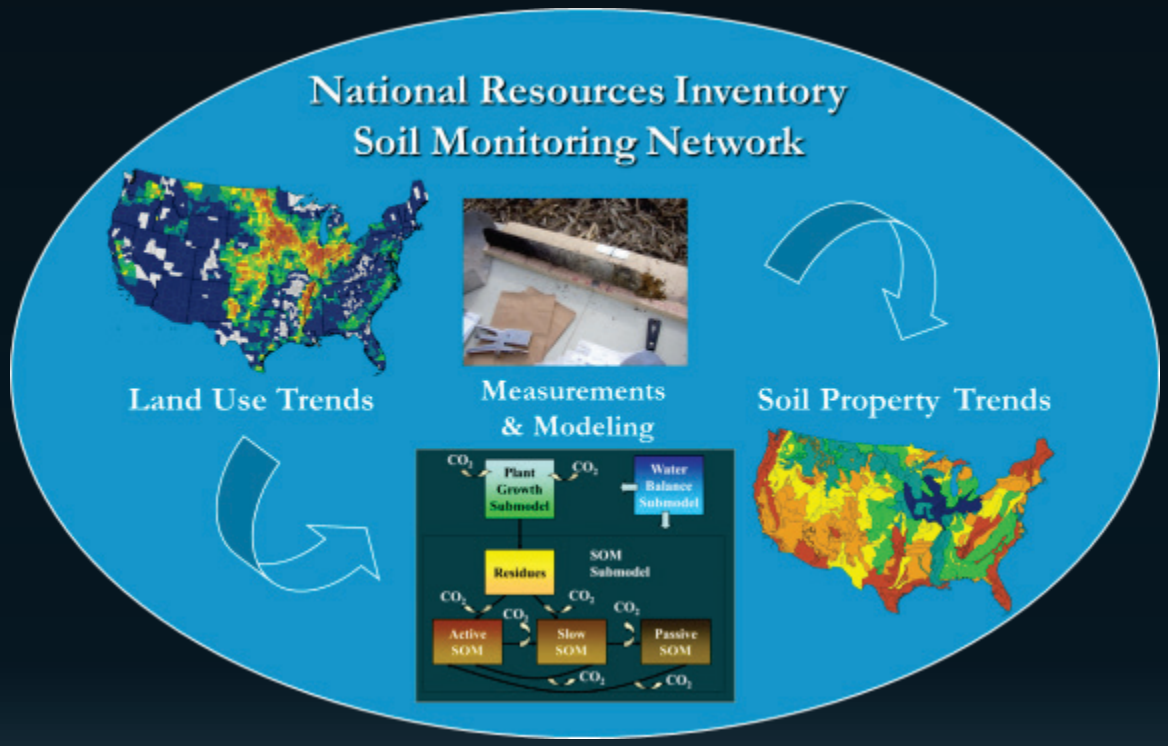
NRI Soil Monitoring Network



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Goals of the Monitoring Network

- Monitor soil carbon and other properties over time
- Incorporate soil measures into policy assessments
- Validate models used in CEAP data analysis
- Sample location criteria:
  - good spatial dispersion
  - in both crop and grazing lands
  - across all major climate and soils types
- Re-visit sample locations every 5-10 years

Build on Existing Monitoring Network

- Leverage the National Resources Inventory
- Stratified two-stage area sample
  - good spatial coverage
  - extensive land use and management info
  - more detailed management info on further subset of CEAP sites

Stratification for Soil Monitoring Network

- Choose from CEAP and non-CEAP NRI sample points in agricultural lands
- Stratify by:
  - Broad land use: crop vs. grazing lands
  - Major Land Resource Area (MLRA)relatively homogeneous climatic conditions and soil types
- Allocate samples across range of textures and geographic coordinates for points in the MLRA

Century Model

- Tillage, fertilization, irrigation, etc. all affect carbon storage
- Century, a biogeophysical process model, describes site-specific dynamics in an agricultural system
  - tracks carbon, water, nutrient cycling over long time scales (centuries to millennia)
  - requires inputs on soils, weather, agricultural management
  - deterministic output for given inputs

Simulating Soil C Dynamics with Century

- **Using Century, simulate change in carbon stock for each NRI point classified as crop or grazing land in the 1990s**
  - **Use NRI land use and management information as input**
- **Compute stratum-level [MLRA*(crop,grazing)] standard deviation of Century-simulated carbon stock change**
- **Insert into Neyman allocation**

Neyman + Equal Allocation

- **Start with equal allocation of 3 points in every stratum [MLRA*(crop or grazing)] to ensure minimum sample size**
- **Allocate remaining sample size via Neyman allocation**

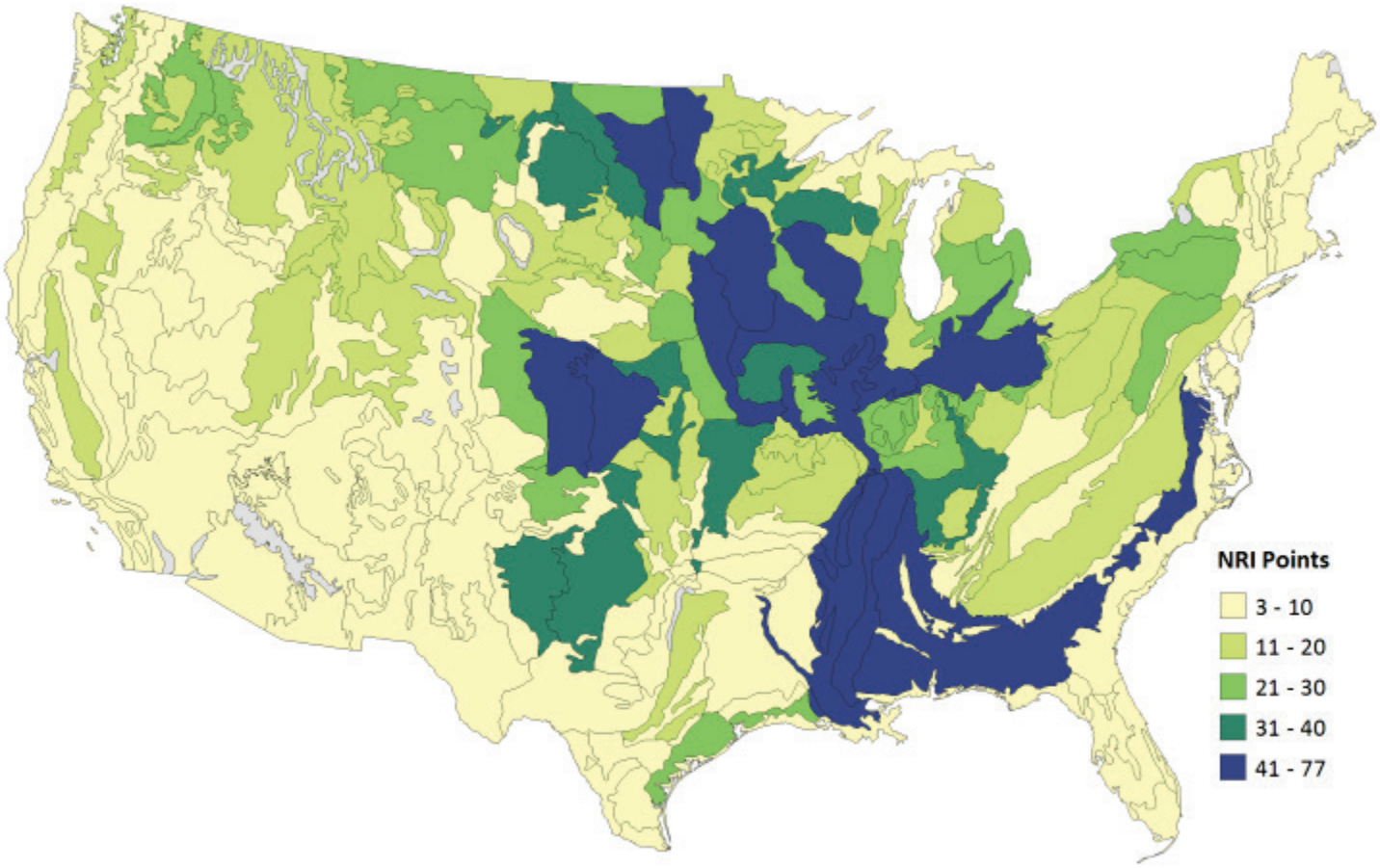
CEAP Allocation

- Emphasize CEAP points within MLRA*Crop strata
  - allocate 3/5 of points to CEAP, if available
  - otherwise allocate as many CEAP points as possible

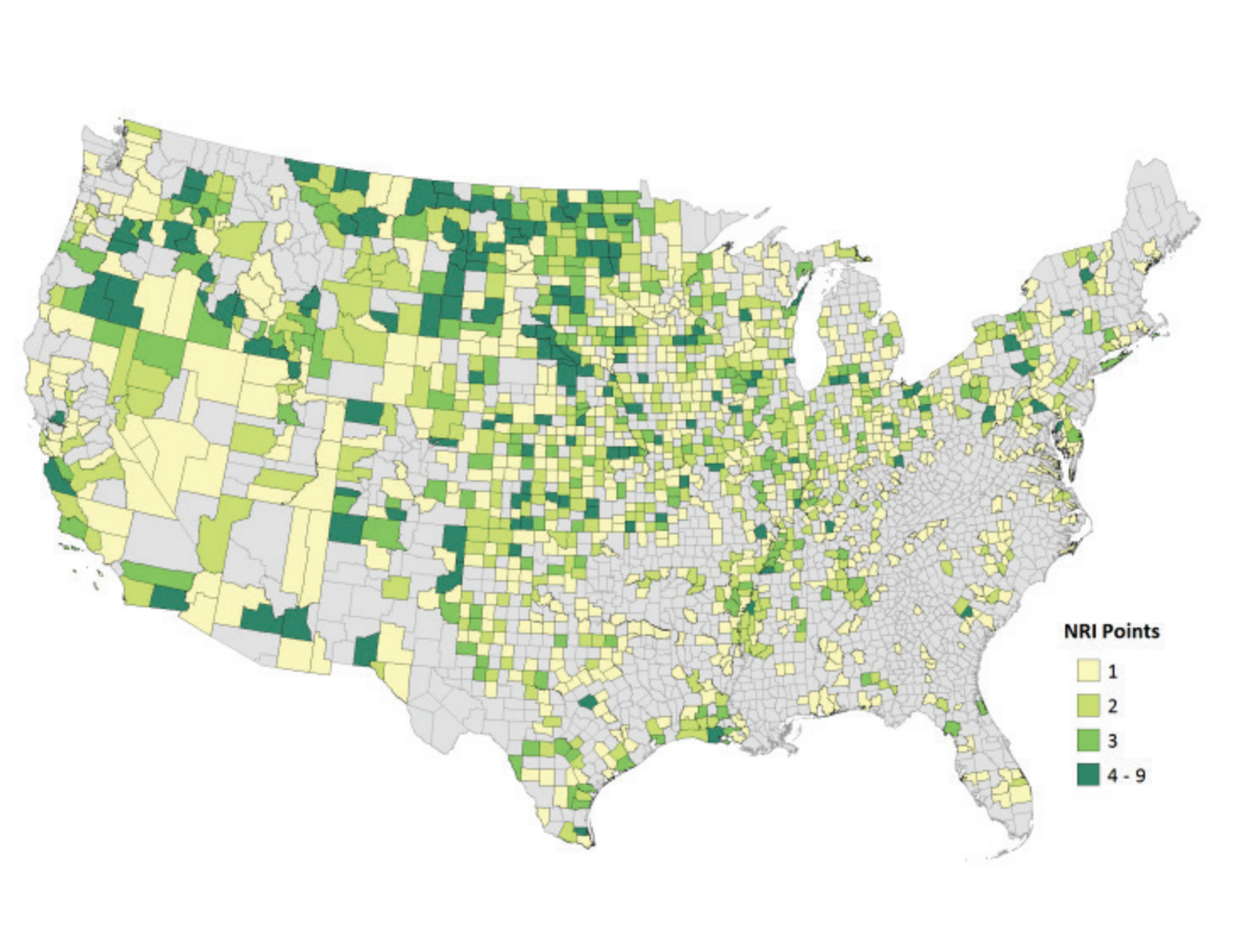
Base Sample and Supplements

- Now sequentially form supplementary samples
- Sample F is a stratified systematic draw of size 1000 from the 10,000
- Sample E is a stratified systematic draw of size 1000 from the remaining 9000
- …
- Sample B is a stratified systematic draw of size 1000 from the remaining 6000
- Sample A is the remaining sample of 5000: this is the base sample

Cropland Sample by MLRA



Cropland Sample by County



Other Considerations

- Can the data from SMN be linked to RaCA points
- Other stratification variables?
  - Texture
  - Drainage Class

Field Campaign

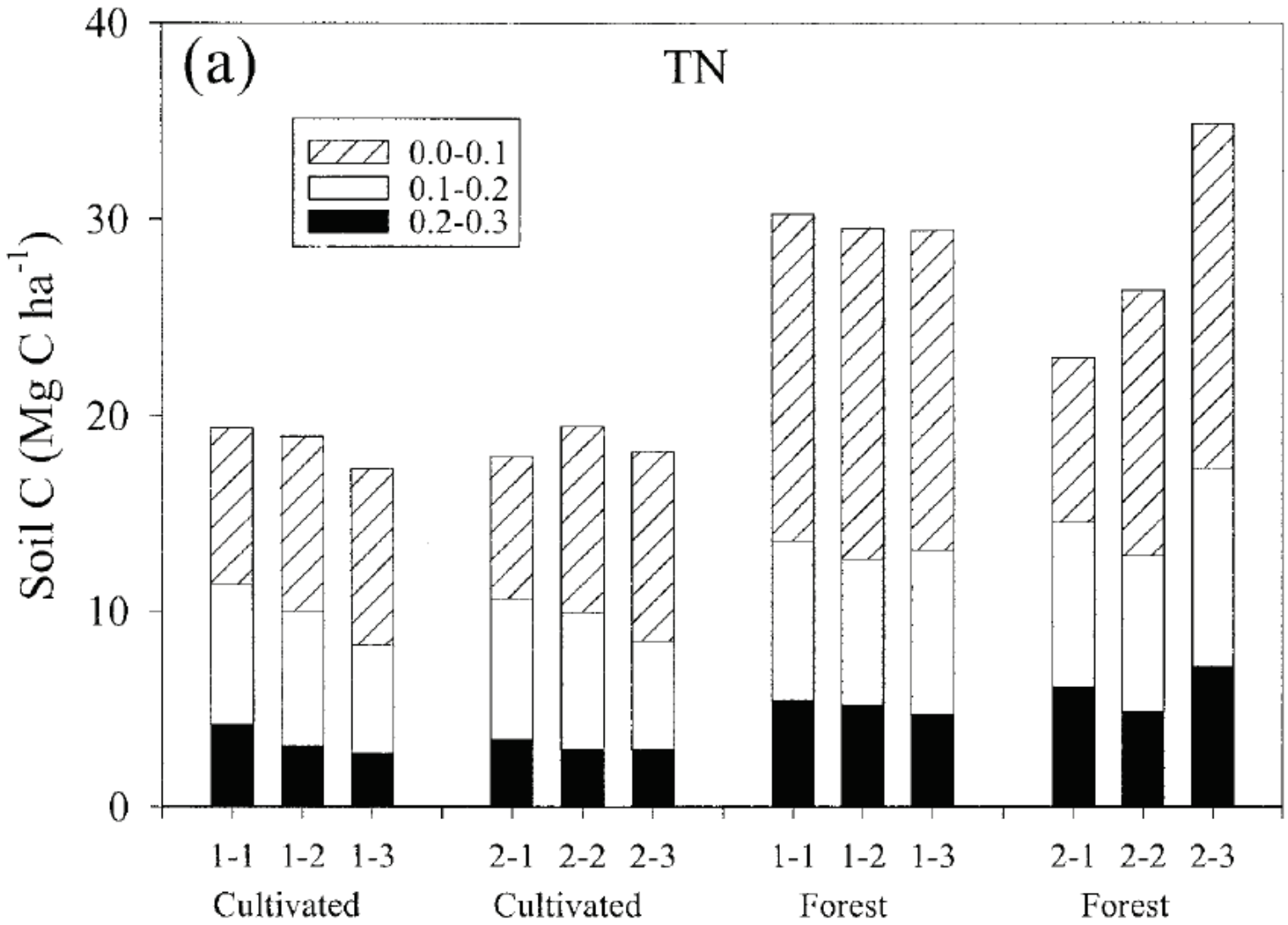
Criteria

- Monitoring at NRI points where management and ancillary data are already collected
- Support resampling at ca. 5-10 yr intervals for 100+ years (i.e., permanent monitoring locations)
- Minimize effects of fine-scale spatial variability on assessing soil C changes over time
- Make efficient use of field resources to achieve high accuracy and precision at monitoring locations.

Key specifications

- Ability to precisely relocate monitoring plots
- Sample profile to sufficient depth for ‘full’ SOC determination
- Differentiate by layers for greater sensitivity to management impacts
- Measure bulk density and chemical characteristics on the same samples to determine ***stocks***
- Also collecting a complete characterization sample for analysis at the NSSC

Soil C stocks by depth for initial and resampled measurements



Plot Layout

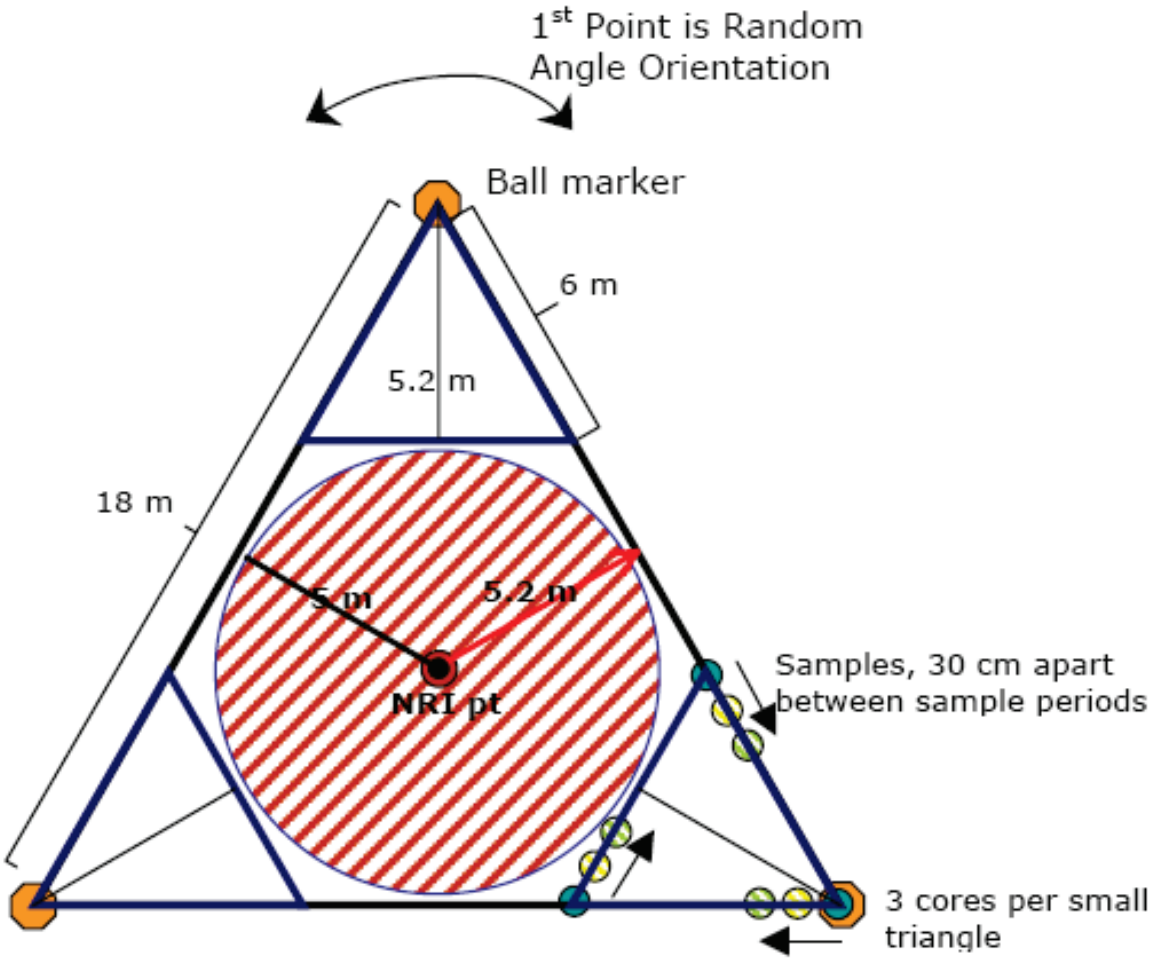
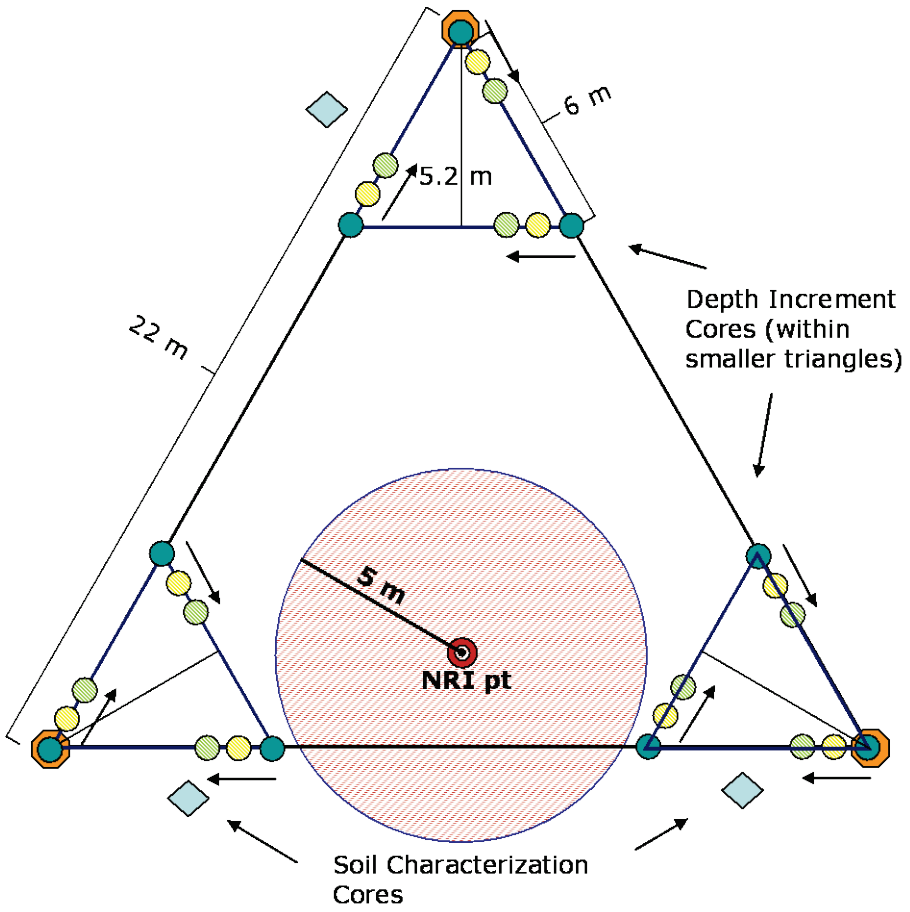


Figure 4. Layout of a monitoring site in proximity to a NRI point location.

Alternative Plot Layout



Preparation

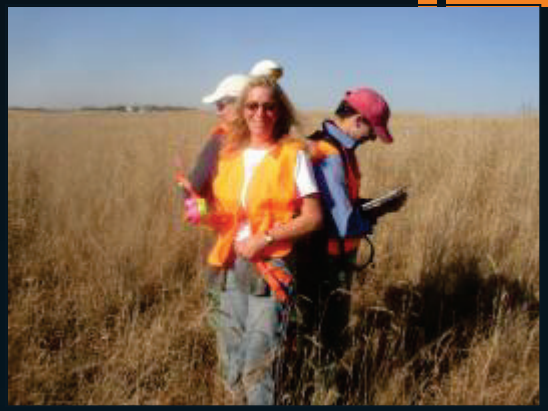
- Select samples from national sample
  - Supplemental sample has alternates
- Contact land owners about permission for sampling
  - Provide talking points
  - DCs made the contacts during the pilot
- Contact utility company about buried lines and cables
- Contact CSU about quarantine samples

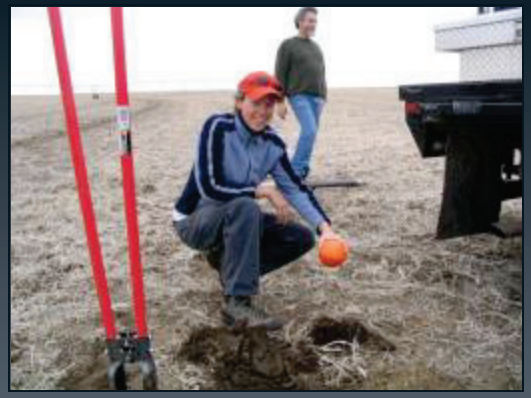
Preparation

- **Check sampling equipment and supplies**
  - **A portion of supplies provided by NSSC Lab**
- **Coordinate with CSU and land owner on dates for sampling**
- **Obtain aerial photos and road maps from NRI**

Field Sampling

- Find site ctr. pt.
- Layout design
- GPS
- Site Notes
- Surf. Litter Quads
- Soil Sampling
- Ball Markers





Sample Depths

- **0-10, 10-20, 20-30, 30-50 and 50-75 cm**
- **Rationale:**
  - **Fixed depths best for repeat C measures**
  - **0-10 & 10-20 cm shows sensitivity to management**
  - **30 cm depth is default for IPCC methods**
  - **75 cm can be typically reached with one core without compaction and captures most of rooting depth**
  - **100 cm would be aesthetically satisfying, but is often difficult due to subsoil barriers**

Shipping to CSU

- **Ship in coolers or reinforced boxes**
- **Identify quarantined soils**
- **Labels can be provided by CSU**
- **Local team will need to cover shipping costs**

Analyses - all triangles

- Bulk density

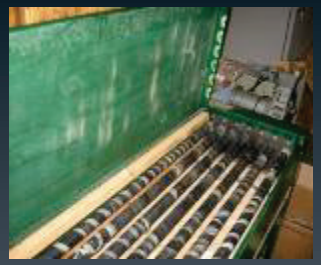
Using data on moisture content (110°C), rock and soil residue weights and volume soil core

- Soil residue / root C

450°C combustion of litter fractions: ash content determination

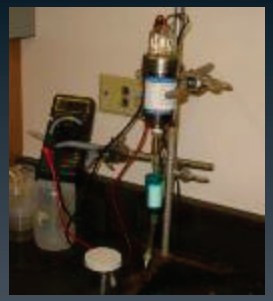
Calculated as ash-free dry matter, with 45% assumed C content

- Total Soil C and N



C and N analyses done on oven-dried (110°C) ground subsample of the air-dried 2-mm sieved soil

- Soil inorganic C



Fizz test to check for carbonate presence (2M HCl)
Pressure transducer method for quantifying inorganic C

Analyses – triangle A only

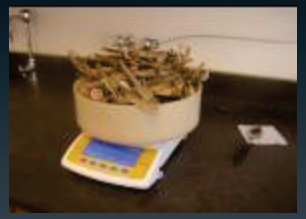
Soil texture

- Performed on ~30g of 2-mm air-dry soil (special procedures for quarantine soils)
- (1) dispersion, (2) sieving, (3) suspension density analysis
- Moisture determination (110°C) for oven-dry correction

POM mass, C and N

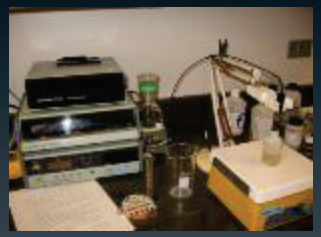
- Performed on ~30g of 2-mm air-dry soil (special procedures for quarantine soils)
- (1) dispersion, (2) sieving, (3) oven-drying (60°C), (4) grinding, (5) CN analyzer

Surface litter C



- Performed on oven-dry litter
- (1) grinding, (2) CN analyzer

pH

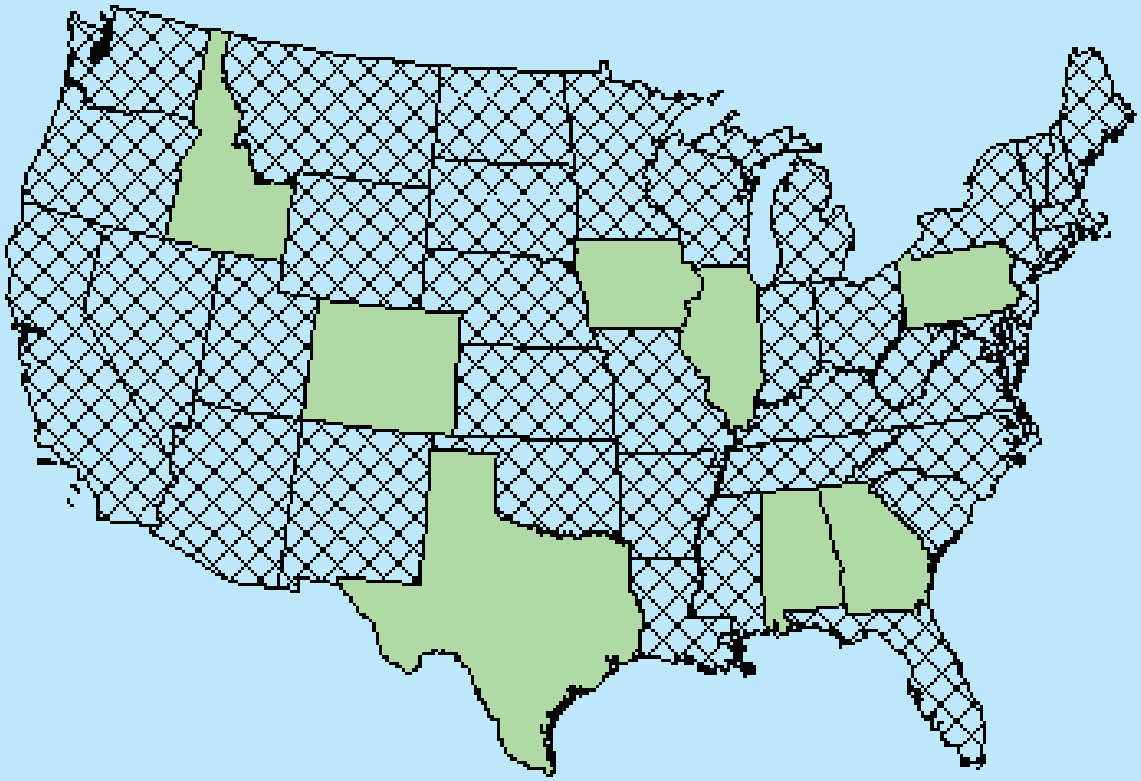


- Performed on ~5g 2-mm air-dry soil
- Soil slurry, using 0.01M $CaCl_2$
- Electronic pH meter with electrode

CEC

- Performed by CSU Soil Testing Lab (equipped for quarantine handling)
- ~10g 2-mm air-dry soil
- Displacement or summation method
- ICP measurement of displaced or exchanged cations

FY 2012 Sampling



SAMPLING IN PENNSYLVANIA

April 4-6, 2012

LAYING OUT THE TRIANGLE

USING A GIDDINGS PROBE

HOW DOES THIS THING WORK?

NINE CORES ARE COLLECTED

AND DESCRIBED

ISN’T RETIREMENT GREAT!!!

MARKING THE LOCATION

UTILITY MARKERS

SAMPLES ARE COMPOSITED, BAGGED, AND LABELED

A TOOL TO PROBE THROUGH ROCKS!

IT WORKS LIKE AN ICE AUGER

A TWO PERSON OPERATION

2-3 SITES SAMPLED PER DAY!

SOIL MONITORING NETWORK – 2013 PLANS

- Everything Depends On Budget !!!
- Resource Inventory Division, Soil Science Division, Resource Assessment Division Need A Long Range Plan!
- Plans Are to Visit Same Eight States In 2013 Plus Four More
- Possibly Resample Several Sites From Pilot In 2007
- Continue To Accelerate Until 5000 Points Have Been Established

Send questions to
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