Combining National Forest Inventory Data with Soil Drainage Index to Assess Forest Health Vulnerability

**BACKGROUND AND HYPOTHESES**
- Assessing the health of America’s forests is central to the mission of Forest Health Protection to foster resilient and adaptive ecosystems.
- Depressed growth and higher mortality, resulting from physiological stress, compromises long-term forest health.
- Drought/drought causes physiological stress, but can be exacerbated by site variables such as soil and topography.
- Previous work defined ranges based on geographic, bioclimatic, basal area (BA) distributions.
- Goal: define margins and interiors based on soil drainage index, examine mortality and growth rates over time.

**Hypotheses:**
- Mortality in range margins > interiors.
- Growth in range margins > interiors.

**METHODS**

**Response Variables: Tree Mortality and Growth**
- Forest Inventory and Analysis (FIA) database.
- Subject re-measures allow calculation of mortality and growth rates at time steps of 5-10 years.

**Change in live and dead basal area over time were assessed for:**
- Dominant and co-dominant crown classes only.
- Untreated and disturbed subplots only.
- Most recent re-measurement only.
- Mortality was from any cause (fire, insect, disease, suppression/competition).
- Mortality rate = Needy basal area/initial basal area per year.
- Growth rate = average tree basal area increase per year.

**Range-defining Variable: Soil Drainage Index**
- Taxonomy based index of soil wetness (Schwantel et al. 2009).
- Major contributors: soil moisture regime, natural soil drainage class, sub-group modifiers (freshwater, shallowness to freshwater, etc.), slope gradient.
- Soil taxonomy data obtained from SSURGO, gaps filled with National Forest System survey data and modeled DI values (Krist et al. 2015).
- DI classed into 6 classes and assigned to each FIA subplot.

**Statistical Analysis**
- Defined tree range margins/interiors based on distribution of FIA subplots among DI classes for each species (Figure 1).
- Mean mortality and growth calculated for margins vs interiors for each species.
- Significant increase in mortality or decline in growth in margins vs interiors for each species tested using randomization tests (n=5000) at the P = 0.01 level.

**RESULTS**

**Douglas-fir (Pseudotsuga menziesii) showed significantly higher mortality and lower growth in places with a very dry soil drainage index. Identifying these margins could help project areas at risk for future mortality.**

**Loblolly Pine (Pinus taeda) showed significantly lower growth in places with soil drainage index very dry to dry mean. Slow growth can reduce productivity and affect rotation lengths for this economically-important timber species. Identifying these margins could help managers plan where to plant and thin.**

**Northern Red Oak (Quercus rubra) had significantly lower growth in places with a very dry soil drainage index. Identifying these margins could help managers better plan where to prioritize planting and planning for timber management.**

**CONCLUSIONS AND NEXT STEPS**
- Different species are sensitive to margins defined in different ways.
- Growth differences in margins vs interiors were more pronounced than mortality differences (Table 1).
- Table 1: Number of species in each group with significantly different mortality or growth based on margin only or combined variable within one or both tails of the distribution.

**REFERENCES**