Global Precipitation Part II: Ecosystem & Mgmt. Implications

Bulletin Synopsis *May 2015*

Why Water Availability Matters

Tree Species Migration – Climate-induced tree species movement is usually a gradual process, but it can happen more rapidly when sporadic mortality events eliminate competition from established species, e.g. severe or long-term decreases in water availability that lead to large-scale forest die-off.

Tree Resource Allocation – Water availability, including the amount and timing of rainfall, is critical to forest structure because it changes how individual trees allocate their resources between the above and belowground portions of the stem:

- Drier conditions = ⇧ fine roots + ⇩ foliage & aboveground woody biomass
  - Improves ability to draw on limited soil water
- Wetter conditions = ⇧ foliage & growth rate + ⇩ fine roots
  - Capitalizes on growth potential and increases competitiveness, but shallower root system increases risk of blow down and vulnerability to future drought

Water Stress and Forest Mortality

Researchers have documented widespread tree mortality – impacts in wet areas, as well as semi-arid regions, indicate that increasing temperatures may play a role, by increasing water loss through transpiration, reducing tree vigor, and accelerating insect life cycles. Drought-related mortality is thought to occur via three interrelated pathways – carbon starvation, hydraulic failure, and biotic attack. An emerging picture is that trees may not obviously show the effects of drought stress until several years after the event.

Evaluating Drought Risk

Evidence suggests we will experience more frequent and severe drought due to climate change, but this risk varies with site characteristics and forest type:

- Warmer temperatures increase **intensity** of individual drought events by increasing water loss through evapotranspiration.
- Site characteristics, including soil texture, depth to water table, and topography, influence drought **exposure** by affecting soil water holding capacity, run off, and evaporation rates.
- The species mix (specifically the level of drought tolerance exhibited by each tree species) determines **vulnerability** to drought.

Sites that experience large increases in temperature and decreases in precipitation, with low soil water holding capacity, and a drought-intolerant species mix will have the highest levels of drought risk. In contrast, an area may have a high likelihood of intense drought in the future, but the risk may be mitigated by a drought tolerant species mix and better site conditions.

Reducing Drought Risk through Management

Land base – Focus on sites with soil and topographic characteristics that generally retain moisture

Species mix – Use silvicultural techniques that favor regeneration of drought tolerant species; Plant genotypes from warmer and dryer areas of a species range

Reduce Stocking – Studies in different forest types throughout the U.S. and Europe (primarily in pine-dominated systems) highlight the utility of thinning for moderating drought impacts on growth, increasing drought resistance, and improving the speed of recovery after drought events.

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