1. CLIMATE CHANGE AND FOREST GROWTH

Forests of the western United States are in a period of rapid change, due in part to climate driven changes in growth, establishment, and mortality. These changes are of particular concern in the American Southwest where climate conditions are projected to become increasingly hot and dry throughout the next century. While lower elevation trees of this region are already experiencing decreased radial growth in response to warmer temperatures, the response of high elevation trees to future climate is highly uncertain.

We use dendroclimatological techniques to explore climate-mediated changes in radial growth over time in the high elevation forests of SW Colorado by sampling 450 Engelmann Spruce and 210 Subalpine Fir from 22 sites across varying aspect, elevation, and soil type.

We find that while Engelmann Spruce display relatively low sensitivity to climate, Subalpine Fir have much greater sensitivity, particularly negative responses to warm summer temperatures, and trends of decreasing growth on specific landscape positions.

2. STUDY SITE: SAN JUAN NATIONAL FOREST

22 sampling sites were chosen within Spruce-fir forest to include varying elevations, aspect, and soil types.

3. CLIMATE TRENDS IN SAN JUAN NATIONAL FOREST

a) The region of San Juan National Forest has experienced a trend of warming in recent years, observed in NOAA Divisional Data (all of Western Colorado) and SNOTEL data within the San Juan Mountains.

b) Predictions of four regional climate models forecast increasing seasonal minimum and maximum temperatures, with increases of several degrees C by 2070.

4. HOW DOES CLIMATE AFFECT GROWTH?

Investigating growth-climate relationships: Ring width data were detrended to remove the effects of tree age and disturbance. The resulting detrended ring widths were compared to monthly climate data from the NOAA Divisional Dataset 1895-2012 to calculate the correlation between growth and climate for each tree.

Subalpine Fir

- High sensitivity to climate
- Subalpine Fir show a negative growth response to warm summer temperatures.

Engelmann Spruce

- Low sensitivity to climate

5. INTERACTIONS: CLIMATE AND PHYSIOGRAPHY

How do climate effects on growth vary across the landscape? Climatic and physiographic drivers of tree growth were investigated using a Generalized Linear Mixed Modeling approach:

- fixed effects
- random effects

Tables: top 3 models for each species, ranked by model fit and physiography.

Subalpine Fir

- growth explained by climate and physiography and their interactions: specifically temperature, elevation and aspect.

Engelmann Spruce

- growth explained poorly by climate and physiography

6. CONCLUSIONS

1. Subalpine Fir show much greater sensitivity to climate than Engelmann Spruce.

2. Subalpine Fir growth is negatively correlated with warm summer temperatures.

3. Both Engelmann Spruce and Subalpine Fir growth are affected by interactions between climate and local physiography.

4. Growth of Subalpine Fir is declining, specifically on east facing landscape positions.

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