Differences in hydraulic strategy show in plant responses to heat and drought treatments

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Drought-related, continental-scale forest mortality events have been observed with increasing frequency in all forest types during the past 20 years. In the future, droughts are predicted to be accompanied with increasing temperatures that could promote forest mortality via its impact on evaporative demand and plant respiration rates. To tease apart the effects of drought and heat on plant physiology and survival we have built an ecosystem scale manipulation experiment to simulate possible climate change effects in pinon-juniper woodland in Los Alamos NM. Five trees from both species under drought, heat, combined drought and heat, and control treatments are monitored closely until mortality. Drought treatment uses plastic ducts 1.2 m above ground, that direct 50% of precipitation away from the site. Heat treatment is produced with air conditioning units keeping the temperature at 5ï,°C above ambient all the time. The measurements are targeted to reveal how the trees die based on the current leading hypotheses of plant mortality mechanisms: hydraulic failure and carbon starvation. The monitored variables range from soil moisture content profiles and meteorological data to plant gas exchange, bole and leaf temperatures, and non-structural carbohydrate content of different tissues.

After two years of treatments our results show consistently that heat and drought treatments reduce or slow down plant recovery from the annual summer drought. These effects are more pronounced in junipers than in pinon pine, and could be related to the differences in hydraulic strategies of these plants. Juniper is a very slow growing, desiccation tolerant species that can continue photosynthesizing in much drier conditions than faster growing, desiccation avoiding pinon pine. However, in contrast with common beliefs of these plant types, our results reveal that even if junipers can tolerate loss of leaf water potential much better than pinon pine they actually avoid loss of xylem conductivity more strictly than pinon pine.