**3. TECHNICAL SUMMARY**

Aspen communities are the only deciduous vegetation type with large extents in the western mountains and are considered to be biological hotspots at risk from climate change that could result in cascading losses of animal and plant species in the region. Land and water managers will benefit from increased knowledge of the potential viability of aspen stands under projected climate change in order to prioritize stands for active management and to adapt to potential changes to water resource availability. We used a multi-disciplinary approach to investigate biophysical controls on aspen productivity and survivability in landscapes of the interior Pacific Northwest, and to specifically project the likely effects of altered moisture and fire regimes on aspen under climate change. The objectives of this research were to: 1) Determine how aspen productivity varies as areas transition from snow- to rain-dominated precipitation regimes; 2) Determine how post-fire aspen regeneration and productivity vary along existing winter- to summer-dominated precipitation gradients; 3) Determine how interactions between shifting patterns of water balance and fire regimes under climate change will influence future aspen distribution and productivity at landscape scales; and 4) Determine how the combination of climate and vegetation change will affect the water balance dynamics of areas currently colonized by aspen.

To accomplish these objectives, we integrated ecosystem process, hydrological, and disturbance models that are well-grounded in either empirically-derived relationships or fundamental physical processes. Specifically, the effects of climate change on snow redistribution and vegetation net primary productivity (NPP) at the Reynolds Creek Experimental Watershed (RCEW) were determined by merging the results of the snowpack mass and energy-balance model iSnobal, with the biogeochemical model Biome-BGC MuSo. The outputs from the Biome-BGC simulations were used to parameterize the landscape simulation model LANDIS-II to determine the probabilities of aspen establishment and mortality, and forecast aspen distributions over RCEW. The hydrological effects of both climate change and aspen mortality were assessed using the Simultaneous Heat and Water (SHAW) model to provide insight into the relative sensitivities of each change on flow regime.

The primary results of the aspen biogeochemical simulations indicated that at the lowest elevations with the warmest snow regimes, NPP was reduced by 27% under mid-21st century conditions indicating that warmer spring temperatures coupled with increased spring growth are not always sufficient to compensate for drought induced reductions in productivity that occur later in the growing season. Unlike mid-elevation sites, the cooler, high elevation site RME experienced large increases in spring NPP under mid-21st century conditions resulting in a net increase in annual NPP under mid-21st century conditions. <<**Doug** – please add a few points about the key findings >> However, regeneration declined while mortality increased, leading to a net decline in aspen biomass and areal extent. Snowbanks allowed microsites to maintain aspen for longer periods, although they also declined in biomass and extent; many snowbanks entirely lost aspen cover under moderate and high C emissions climate scenarios. <<**Rob or Alec** – Likewise, please add 1-2 sentences to summarize a key finding>> The hydrological simulations indicated that watershed-scale runoff is projected to decline due to climate warming, but that if aspen mortality simultaneously occurs, that flow increases are likely to occur for modest temperature increases but fall below the historical reference case for larger increases without simultaneous increases in precipitation. The intensive study area spanned the cool snow regime as defined by the new SnowClusters snow classification scheme. This regime covers roughly 50% of the interior Pacific Northwest regional area of interest, and contained 15% of aspen stands that typically occur in relatively small isolated patches. When coupled with local site-specific knowledge, results from this research can be used to prioritize stands for active management by identifying stands that are most vulnerable to mortality from losses of snow subsidies in warmer climates.