



# Climate and Forest Ecosystems

## Results

### Projected climate change impacts on forest ecosystems:

While there is significant variability between climate change scenarios, all projections include increased temperature and increased levels of atmospheric carbon dioxide. As a result, the following general trends are predicted:

- ◆ Warmer temperatures will cause trees to move northward and to higher elevations
- ◆ Changes in total forest cover for California are projected by one study to range from a 25% decrease to a 23% increase by 2100 (Lenihan et al., 2008)
- ◆ Species with the smallest geographical and climate ranges are expected to be the most vulnerable to change
- ◆ Extended droughts and earlier snowmelt could cause fire seasons to start earlier and last longer (California, 2010)
- ◆ Temperature increases may change the frequency and magnitude of pest infestations such as the pine beetle

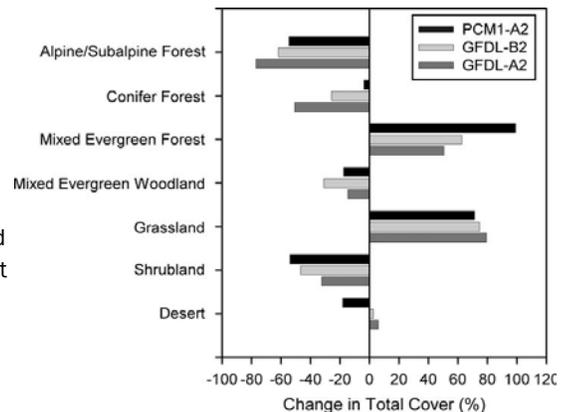


Figure 1 - Fig. 4 from Lenihan et al. 2008. Percent change in total land cover for vegetation classes by 2100 for three climate change scenarios predicted using the MC1 Dynamic Vegetation Model.

### Key Findings

- Warmer temperatures will likely cause Jeffrey pines to move to higher elevations and may decrease their total habitat.
- Forest health may also be influenced by changes in the magnitude and frequency of wildfires or infestations.
- Alpine ecosystems are vulnerable to climate change because they do not have the ability to expand to higher elevations.
- Across the state it is projected that alpine forests will decrease in area by 50-70% by 2100.

### Additional Considerations

- The rate of climate change determines how quickly ecosystems must adapt, and influences the total impact.
- There is significant uncertainty about the role of increased CO<sub>2</sub> levels on forest productivity.
- In general predictions about forest productivity are uncertain and will rely mainly on future precipitation.
- Most available research has focused on the state of California as a whole and no studies explicitly consider the future of Jeffrey pines or alpine ecosystems within the SAWPA area.

### How will the Jeffrey pine ecosystem be impacted?

The Jeffrey pine is a high altitude coniferous evergreen tree that can occupy a range of sites and climate conditions (Moore, 2006). Based on the general trends noted above it is likely that the Jeffrey Pines will migrate to higher elevations and some lower elevation forest area will be lost. Several studies predict that warming temperatures will result in the displacement of evergreen conifer forests by mixed evergreen forests across California (Hayhoe et al., 2004; California, 2010). However, no study has explicitly considered the migration of the Jeffrey pine. Given its versatility it is possible that impacts to the Jeffrey pine may be less than some other species.

### Will the Region continue to support an alpine climate in the local mountains?

Alpine ecosystems are particularly vulnerable to increased temperatures because their habitat range is already limited and they cannot shift to higher elevations. One study projects that Alpine and subalpine forests will decrease in area by 50-70% by 2100 (Hayhoe et al., 2004).

## References

- California Department of Forestry and Fire Protection, Fire and Resource Assessment Program. 2010. *California's Forests and Rangelands: 2010 Assessment*. Chapter 3.7. <http://frap.fire.ca.gov/assessment2010.html>.
- Hayhoe, K. et al. 2004. *Emissions pathways, climate change, and impacts on California*. PNAS, 101:34, pp 12422-12427.
- Lenihan, J. M., D. Bahelet, D. P. Nielson, R. Drapek. 2008. *Response of vegetation distribution, ecosystem productivity, and fire to climate change scenarios for California*. Climate Change, 87 (supply 1), pp. S215-S230. Doi 10.1007/s10584-007-9362-0.
- Moore, L. M. 2006. *Jeffrey Pine Plant Guide*. United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS)