SOUTH CENTRAL
CLIMATE ADAPTATION SCIENCE CENTER

CLIMATE IMPACTS AND ADAPTATION MEASURES FOR SPECIES

Rocky Mountain Douglas-fir

Pseudotsuga menziesii var. glauca

The Rocky Mountain Douglas-fir is an important resource in the South Central CASC region with numerous human uses as well as a habitat and food source for other species. However, this species' future could be in peril if it is not able to adapt to projected changes in climate within this region. From a management standpoint, it is important to consider these changes as part of the adaptation planning processes.

South Central CASC region presence: Throughout New Mexico and in far western Texas in the Guadalupe Mountains (Guadalupe Mountains National Park) and the Chisos Mountains (Big Bend National Park), in mixed conifer vegetation types between 8,000 and 9,500 feet in elevation

Habitat for species of concern in the region: Mexican spotted owl *(Strix occidentalis lucida)* and the Northern goshawk *(Accipiter gentilis)*

Forest product uses in the region: Fuelwood, posts, poles, vigas, latillas, sawlogs, pellets, pulpwood, Christmas trees, boughs, and cones

Indigenous cultural significance in the region: Ceremonial purposes (bough, branches, and stems), various types of medicines, candy, and trade

Climate Sensitivities for Douglas-fir

- *Fire*: Western forests are projected to have more intense wildfires over larger areas in the future. Mature Douglas-fir's thick, corky bark and deep roots make it a relatively fire-tolerant tree, but seedlings are more vulnerable. Its likelihood of survival and reestablishment is reduced with increasing fire intensity and scale. The Douglas-fir seed bank is typically limited due to variable production, two-year seed viability, and animal consumption. Seeds are relatively heavy and fall mostly within 330 feet of a seed-producing tree, making natural regeneration within large burned areas unlikely.
- *Insects and diseases*: Warmer projected temperatures due to climate change may accelerate insect outbreaks, especially with fewer hard freezes that limit insect populations. Droughts can limit resin production, decreasing the tree's ability to flush out insects, such as the Douglas-fir beetle. Greater forest density and number of host trees can also promote additional infestations.

Seed cones

- *Establishment and Growth*: Douglas-fir seedlings are sensitive to soil moisture levels, which are expected to decrease. Seedling growth requires a cumulative chilling period that could be delayed due to projected warming temperatures, meaning lost opportunities when spring soil moisture is available.
- *Cascading Effects*: Increasing drought and insect activity will affect Douglas-fir's vigor and mortality. Higher mortality will result in more fuel for more intense and larger wildfires. Reduced soil moisture and increasing temperatures will limit reestablishment. Douglas-fir is found in isolated, higher-elevation “sky-islands” and is at the southernmost edge of its range here, making migration within this region difficult. High-severity fire may cause a transition from forest to shrub species.

Rocky Mountain Douglas-fir

Adaptive Capacity of Douglas-fir

- *Genetics*: Douglas-fir's extensive range, from Canada to Mexico, suggests the likelihood of high genetic diversity within the species, with this variation promoting the species' ability to survive adverse conditions associated with climate change. However, as a long-lived species, the tree's rate of genetic adaptation may be comparatively low.
- *Management*: Economic drivers from forest products industries for research and professional training are limited in New Mexico and Texas. Some forest planning documents in the region consider climate change.
- *Additional Species Factors*: Douglas-fir may be affected by parasitic mistletoe; fungal diseases, particularly when stressed; and browsing, clipping, and trampling of seedlings by animals.

Climate Adaptation Actions for Douglas-fir

Fire Risk Reduction *– Reduce fuel loads and risks of catastrophic wildfire.*

Site-Specific Planning and Management:

- Define and map current habitat for Douglas-fir, considering topography, moisture, density, fuel loads, insect and pathogen levels, and other factors at small scales, for precise management decisions.
- Use methods such as mechanical thinning, prescribed fire, and allowing natural fire to occur to reduce fuel loads and risks of catastrophic wildfire.
- Develop management plans that minimize maladaption (negative side effects), including impacts on other species and on ecosystem functions.
- Incorporate adaptive management tools such as monitoring and iterative learning into plans, implementation, and funding.

Supporting Actions:

- Encourage workforce development for fuel load reduction and fire protection.
- Use the Tribal Forest Protection Act and Reserved Treaty Rights Lands Program for on-the-ground work.
- Educate community members and leaders about defensible space and limiting development in high-fire-risk areas.
- Empower the use of Indigenous and traditional knowledge about fire.
- Proactively communicate about prescribed burns.

Refugia *– Identify areas not affected by or protected from disturbances such as wildfire.*

Site-Specific Planning and Management:

- Define and map refugia (areas that are less likely to be affected by disturbances such as catastrophic wildfire and other stressors) that may provide continuing or new habitat for Douglas-fir.
- Develop, implement, monitor, and evaluate strategies and management plans to protect refugia.

Supporting Actions:

- Define goals for refugia that include site and habitat conditions, community needs, and access to sites by working with partners, knowledge-holders, and rights-holders.
- Evaluate trees as potential seed sources, and ensure seed tree protection.

Planting *– Plant Douglas-fir seedlings in areas with suitable future climatic conditions.*

Site-Specific Planning and Management:

- Considering current and future habitat suitability, benefits and risks of assisted migration, and community goals for Douglas-fir, define and map potential sites for Douglas-fir reforestation and planting in new areas.

Supporting Actions:

- Collect Douglas-fir seeds from a range of locations. Design and conduct common garden studies to research the ability of Douglas-fir varieties to thrive in new locations.
- Fund and support workforce development for existing and new seedling nurseries.

Dr. Sharon Hausam prepared the literature review and text for this fact sheet. Version 1