

# **Management to promote the resilience of sagebrush ecosystems: invasive species, altered fire regimes, and climate change**

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**Topic:** Natural areas management in light of climate change

**Proposal Type:** Symposium - select this if you are part of an organized session

## **Abstract:**

In the sagebrush semi-desert of the western United States, the invasion of fire-adapted annual grasses such as cheatgrass (*Bromus tectorum*) can initiate a grass-fire cycle that results in the progressive loss of native plant communities. Climate change is exacerbating this risk by increasing the size and frequency of wildfires, expanding the climate niche of cheatgrass and other invaders, and reducing the recovery of native perennial species. The resilience of sagebrush ecosystems to fire is highly variable in space and time, and many recent fires have resulted in the conversion of large areas of valuable habitat to annual-grass-dominated ecosystems. There is thus a pressing need to identify management strategies that can promote ecological resilience given the interacting effects of invasive species, altered fire regimes, and warming climate. In this talk, we will discuss post-fire management options for promoting vegetation recovery in heterogeneous landscapes, based on the results of multiple long-term studies. We will show how landscape-scale post-fire recovery potential is related to environmental characteristics and pre-fire biotic conditions, emphasizing the need to target management efforts in those portions of the landscape that will benefit the most. For example, in the driest portions of the landscape where resilience to fire and resistance to cheatgrass invasion are both low, post-fire management interventions are unlikely to result in the successful restoration of native ecosystems. In contrast, post-fire management interventions are often unnecessary in cool and moist sites at higher elevations, where the rapid recovery of native perennials characterizes a resilient post-fire response. Post-fire management investments often have the greatest benefit in intermediate environmental conditions, including in mosaics of sagebrush shrublands and pinyon-juniper woodlands, where interventions such as seeding have the potential to greatly increase resistance to annual grass invasion. We will share experimental results that demonstrate the effectiveness of post-fire native seeding treatments, and will show how functional diversity can be an effective bet-hedging technique for seeding into heterogeneous landscapes. We will then share research on climate-driven episodic establishment patterns in big sagebrush, discussing how an adaptive management approach that includes repeated seeding can minimize the risk of recovery failure for sagebrush and other key species. Finally, we will discuss how post-fire recovery potential is expected to shift in response to climate change, including increases in the proportion of the landscape characterized by low resilience to fire, and will present management principles for promoting ecosystem adaptation and reorganization in a time of increasing uncertainty.