Proposal to Sierra Nevada Public Lands Management Act

Robert Scheller, Associate Professor, Portland State University

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Managing large forested landscape in the context of a changing climate and altered disturbance regimes presents new challenges and require integrated assessments of forest disturbance, management, succession, and the carbon cycle. Successful management under these circumstances will require information about the inherent trade-offs among multiple objectives and improved awareness of the opportunities for spatially optimizing management on the landscape. Improved information about the projected impacts of climate on forest communities, disturbance feedbacks, and the effectiveness of mitigation strategies is also required.

Under prior SNPLMA funding, we evaluated the effects of fire suppression, wildfires, and forest fuel (thinning) treatments on the long-term potential for Lake Tahoe Basin (LTB) forests to sequester carbon under climate change. We assessed the tradeoffs among management for C sequestration, mechanical fuel treatments, and stochastically recurring wildfires. Predicted changes in climate and ignition patterns were simulated in response to future climatic conditions, vegetation dynamics, and fuel treatments to examine the long-term effects on C emissions, forest structure, and forest composition. We also evaluated climate change effects due to drought induced stress on forest productivity and mortality due to bark beetle outbreaks. Furthermore, we evaluated forest treatment options for mitigating mortality from bark beetle outbreaks and their effectiveness. This previous effort resulted in 5 published or in-press manuscripts with another in review. Workshops were held to communicate our results to forest managers. More importantly, we compiled extensive data on the vegetation of the area and now have a fully calibrated model (LANDIS-II) that can be deployed to further explore alternative management scenarios, dead wood dynamics, habitat dynamics, and other outputs relevant to the new science initiative within the LTB.

Specifically, I propose to extend this research across the entire LTB as follows:

* Include new management scenarios that encompass fuel treatments beyond the Wildland Urban Interface (WUI). Prior research limited simulated management to areas immediately within or adjacent to the WUI, consistent with previous management plans. A new initiative to expand treatments beyond the WUI will benefit from simulations of effectiveness (measured as reduction of fire risk) and consequences for other ecosystem services.
* Explicit linkages to efforts from the science team. Our modeling platform can serve as a centralized platform to serve data relevant to many ongoing research efforts including hydrology, smoke modeling, erosion, bird habitat, etc. Doing so will require adding additional model outputs and/or providing cross-walks from model output to necessary inputs for these other efforts. For example, model linkage to hydrology can be facilitated by outputting projections of precipitation minus evapotranspiration, given climate change, disturbances, and management.
* Improve fire modeling under climate change. Prior simulations can be improved through a new integrated fire modeling module that, a) explicitly captures the influence of climate, fuels, topography, suppression, and fuel treatments, and b) can be parameterized from available exogenous (e.g., remote sensing, expert opinion) and endogenous (existing within the model: species, age, biomass) data. Inputs should be tractable with solutions that can be estimated from remotely sensed data and/or readily resolved using spatial data. This effort will also benefit related research in the southern Sierra Nevada and Klamath ecoregions.
* Tightly integrate hydrology. After discussion with Adrian Harpold, we see a huge opportunity to advance hydrology and landscape change. LANDIS-II already incorporates some hydrologic processes. Adding a few key additional processes would allow for integrated assessments into the future, albeit at coarser resolution than for any one watershed.

Low Budget: Including only the first three items above will require a full-time post-doc for one year, one-month of my summer salary, and travel: ~$150,000.

Mid Budget: Adding improved fire modeling will require 6 months of technician effort and additional programming: ~$200,000.

High Budget: Adding hydrologic modeling: ~$250,000.